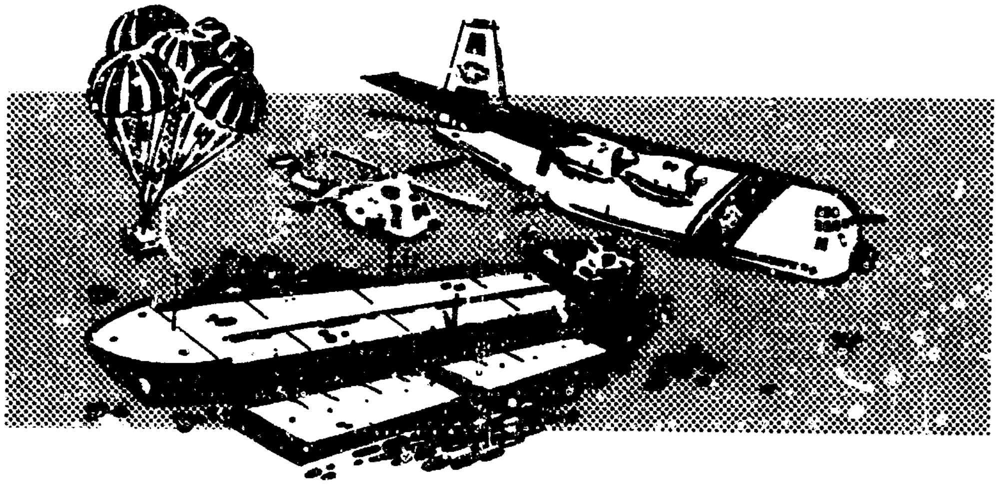
COAST GUARD

THE OPERATIONAL CAPABILITIES OF THE PROPOSED



Air Deliverable Anti-Pollution Transfer System (ADAPTS)

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Department of Transportation

United States Coast Guard

A Report on the Operational Capabilities of the Proposed Air Deliverable Anti-Pollution Transfer System

Volume 2: Documentation of the Simulation Model, BAGSIM

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CHAPTER 1

BACKGROUND INFORMATION

Description of ADAPTS

The equipment that the Air Deliverable Anti-Pollution Transfer System requires on scene is comprised of 500 ton capacity rubber tanks (hereafter called bags or bag pkgs) which are packaged to be air delivered and dropped by C-130 aircraft and of 1,000 gallon per minute pump and prime mover sets (hereafter called pumps or E pkgs) which also are packaged to be air delivered and dropped by C-130 aircraft. These packages are used at the scene of an oil pollution incident before a major spill can occur or during the spill to minimize the spill. While the system is not designed for use after a spill, the development of adequate boom and sweeping equipment may allow application of ADAPTS in those instances.

The personnel that the system requires on scene varies with the amount of equipment and the duration of the incident. For purposes of this study the assumption was made that a four man salvage team was needed for each pump used on scene when the deployment is a period of twenty four hours or less. Also there is personnel support equipment delivered to the scene by any means to provide food, bedding, lighting, and communications for these personnel.

Transportation of the equipment and personnel is provided by C-130 aircraft from Elizabeth City Air Station (ECAS) and by HH-52A or HH-3F

helicopters from the air stations nearest the incident. The system is designed for use with the current inventory of Coast Guard aircraft but, should the workload warrant, aid from the Air Force could be obtained or additional aircraft may need to be purchased.

The concept of ADAPTS and its use places additional requirements upon the aircraft, the air stations, and the personnel stationed there. One hopes there will be no need for additional aircraft and personnel but there will be a definite need to improve cargo handling capability at the air stations. In order for ADAPTS to be deployed in a timely manner, i.e., first units on scene within four hours, the C-130's must be configured for loading and dropping the heavy packages rapidly. Means for bringing the packages to the C-130's must be improved for safety and speed. Likewise the HH-3F's are expected to deliver in slings the prepositioned E pkgs. Additional slings are needed and the time that sling installation requires must be reduced.

The System consists of several categories of equipment and personnel. The categories are broken down for purposes of description[1] into four subsystems:

a. ECAS with C-130 aircraft and ground support.

b. Two other air stations (HP1 nearest to the incident and HP2 next)

c. The aircraft delivered pumps and tanks which are the ADAPTS peculiar equipment.

d. The salvage teams with life support equipment.

The manner in which these interact during deployment is shown in Figure 1.

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1 These are described in detail in Volume 1.

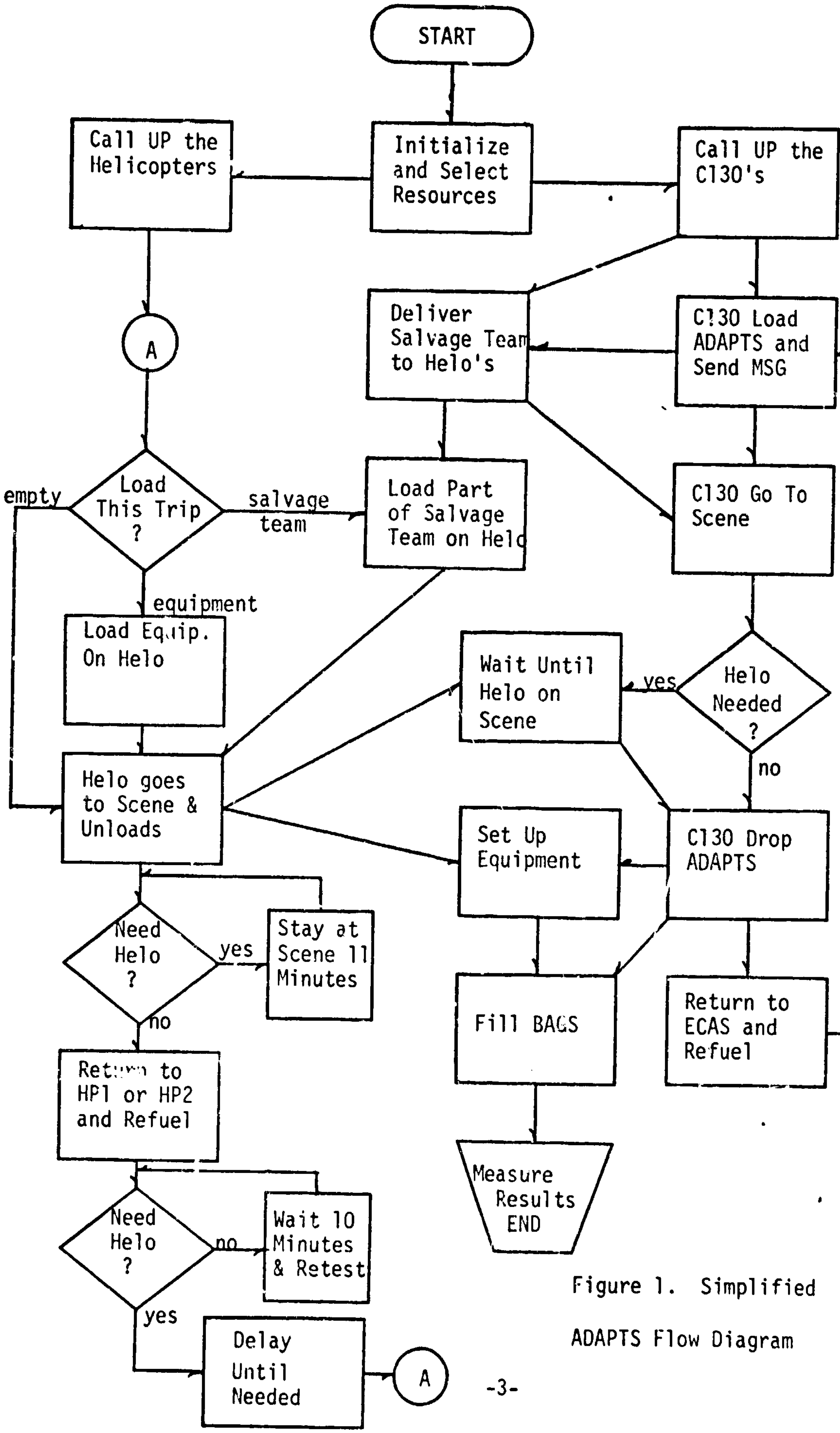

Figure 1. Simplified ADAPTS Flow Diagram

Assumptions

The study was conducted to discover the upper bound on the capability of the system. This allowed the assumptions of good weather, a 20,000 ton tanker cargo in danger of spill in a location where ADAPTS can be delivered, and no machinery or material failures. An adverse condition in any one of these basic assumptions reveals the lower bound of the problem: no bags filled. The actual results will lie between these bounds. For a given set of resources and distances, the manager can determine the upper bound with the model and from that and the extent to which the assumptions are violated he can estimate the actual capability of the system in any given instance.

At least one C-130 and means of loading it are needed. The assumption used in the model was that these were available for use immediately. That is, the C-130 was fueled, had a rail system installed, and was positioned for ease of loading and taking off. An air crew for the C-130 was assumed to be either ready immediately or to be ready before the C-130 was loaded. Loading was assumed to start immediately for the first trip of the first C-130. The standby and availability of following C-130's is variable; however, for all C-130's the assumption was made initially that once they become available, they remain available for the duration of the incident regardless of crew endurance and scheduled maintenance (We will see later the effect of changing this assumption). Naturally the prior assumption of no material failures holds here.

At least one helicopter is needed. All helicopters were assumed to have slings either installed or immediately attachable; that is, there was no time delay for installing slings but an allowance was made for loading and

unloading the helicopters. The fuel consumption of the C-130's and helicopters is assumed constant for the speeds used and loads carried. See Table 1. The helicopter endurance per trip was derived by computing the amount of fuel it can carry with the load (people, E pkg, or empty) and converting this into time. The time required to go to the scene, return from the scene, and a half hour reserve were subtracted to form time on scene. It must be greater than 10 minutes for the helo to be useful with the load it is carrying. If not the problem is stopped. It is assumed that an HH-3F carries a complete E pkg in one trip while an HH-52A carries 1/3 E pkg per trip for three trips. These assumptions were made to compare HH-3F's with HH-52A's, to allow HH-52A's to be considered for carrying E pkgs, and to limit the times involved. While an HH-3F could carry 1/3 E pkgs a great distance, the distances involved and the time required for three trips would reduce output drastically. Such a combination is of academic interest only; it is not practical, hence it was not incorporated into BAGSIM.

The results reported herein are based upon the assumption that the size, weight, and capacity of the prototype pump and bag remain unchanged when ADAPTS is purchased in quantity. This means that only two packages can be carried by a C-130 per trip. The model will require extensive minor changes to accommodate changes in the pumps and bags but these changes are easily entered.

The tanker was assumed to be a dead ship, none of its equipment usable, and its crew unable to help the salvage team. No commercial salvage undertaken and no supporting Coast Guard ships were two more assumptions for the purpose of deploying up ADAPTS within a 24 hour limit.

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TABLE 1

AIRCRAFT PARAMETERS

PLANE	SPEED IN KNOTS OUT	BACK	CAPACITY f=fuel c=Psngrs & Cargo	RESERVE FUEL	REFUELING RATE IN MINUTES LOW	MEAN	HIGH	FUEL CONSUMPTION RATE #/hr.
HH-52A	85	95	2000# f&c	1/2 hr-200#	15	20	35	400
HH-3	115	125	7000# f&c	1/2 hr=600#	20	30	50	1100
C-130	270	290	17000# c @ 45000# f	1 hr=4000#	30	40	60	4000

Each bag delivered was assumed to drop and anchor about 100 yards from the tanker and the bags once filled were assumed to be out of the problem. This latter assumption is based upon the consideration that, by the time enough bags are filled to be a problem, surface vessels capable of moving them will be available. Hence, this final part of the problem is not considered. For the former assumption, 100 yards was picked from the results of the April 1970 test of the prototype. The distance could have been made a probabilistic variable with mean value of 100 yards but was fixed for purposes of comparability of results for the upper bounds.

Food, water, clothing, shelter, and communications equipment for the salvage team were ignored in the model under the assumption that they can be delivered piecemeal to the scene by helicopters without materially affecting on scene endurance. Such support could also be delivered by parachuted packages from HU-16E's or C-130's or by cutter depending upon circumstances.

The good weather assumption * was further defined as:

wind less than 25 knots

visibility more than 8 miles

chop less than 5 feet

clouds at or above 1000 feet (if any).

The final assumption used to formulate the model was that the available resources in aircraft were not diverted for any other use. That is, if a problem run of the model started with eight C-130's, it ended with the same eight C-130's.

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* The Specific Operational Requirement (SOR) for ADAPTS is more demanding. Restricting the study to good weather allows us to ignore weather as a variable.

During the construction of the model some additional assumptions were made on the sequencing and priority of helicopter operations etc. These strategies will be described with the model in the following chapters since they are modeling assumptions.

The Simulation Language

GPSS-360/Version 2 is the language used for the computer simulation of ADAPTS. It is a block command oriented language with special blocks for queuing problems. The deployment of ADAPTS is a queuing problem since the following queues can and do form as the resources are varied:

a. C-130's waiting for loaders

b. C-130's waiting for drop zone

c. C-130's waiting for helicopters

d. Bags waiting for HLD's

e. Bags waiting for pumps

f. Bags waiting for helicopters

A queuing or waiting line problem has several parameters which GPSS automatically stores, tabulates, computes, and displays. Among the more useful are for each queue:

a. the number that wait

b. the number that do not wait

c. the average wait for all

d. the average wait for those who wait

e. the maximum length of the waiting line

f. the average number in the waiting line

g. the current number in the waiting line

The model is constructed so that these values are displayed after 10 bags and 40 bags have been filled to provide data during and after a run.

A program is built in GPSS by defining storages and facilities (single capacity storages) for which the language computes usage statistics. For example a storage could be assigned the capacity of 2 and be named pier 1. The program could be written to have ships arrive at pier 1 every 4 ± 3 days

for stays of 5, 10, 15, 37 hours and the questions of how many ships have to wait per week and how many hours of the week the pier is idle are to be answered automatically. Ships too large for pier 1 are rejected or can be sent to pier 2 depending upon priority of cargo.

The blocks of the GPSS language define what is being done including: time delays, conditional routing, computations and value saving, and reassigning values amongst others. Values can be initially set, computed during computer run, or placed into the program as constants. This is a representative list; not an exhaustive list of the block capabilities.

The blocks to be used are given descriptive values which describe the action of the block. For example the block ADVANCE can be given the values ADVANCE p12, FN5 which means the transactions reaching that block stays there for the average time it has stored in its twelfth parameter plus or minus time given by function 5.

The GENERATE and the SPLIT blocks create transactions which are numbered areas of computer storage. The transactions can be assigned identities such as first C-130, helo 1 or message 37. The GPSS compiler has an internal clock routine built into it which asks what happens at this time and when nothing else is due to happen at this time in the simulation it asks what happens next in the simulation and advances to that time. Things happen to (or are done by the) transactions by figuratively routing the transaction through the sequence of block commands. This is done by having the transaction storage area in the computer contain the current block number, the block departure time, and the next block number as well as the other values which define the transaction. When the action

required at the current block is completed by (on) the transaction, the next block is approached by the transaction; if it enters, the action required is taken. This process continues for that transaction and only that transaction until the transaction is refused by a block or the block requires a time delay. Then the GPSS clock routine goes on to the next transaction. This point is important, if two transactions are to take action at the same time, regardless of priority, the first one encountered by the GPSS clock routine moves first. The ADAPTS simulation model (BAGSIM) has extra blocks added to it for the sole purpose of defining the priority of simulataneous events should they ever arise.

A more complete description of GPSS may be found in reference 1 and the relative merits of computer simulation are discussed in reference 3.

CHAPTER 2

MODELING ADAPTS

Model Requirements

The prime requirements placed upon BAGSIM are that it accurately portray the ADAPTS deployment process and that the model be clear and easily understood. A secondary requirement is that the input for a simulation run be easily identified and entered. To meet these requirements extra detail was added to the model. Comment cards were added and comments were placed on the same card as the command to help interpret the effect of that command. For example:

```
SPLIT 1, HHG82    UNLOAD HELO2
```

Here the block SPLIT caused one duplicate transaction to be created in CPU. It is sent to the program address HHG82 and represents an E pkg that has been unloaded from HELO2 which is the parent transaction. The parent transaction continues along its sequence of blocks until it encounters a delay and then the GPSS clock goes to the next transaction that can move during that time; it may be the E pkg. Sometimes the comment on a card indicates what will happen next, this is done when unconditionally transferring to a routine. A single asterisk on a comment indicates that that card was used on an initial simplified version of BAGSIM and remained unchanged through the development of the model. Three asterisks on a comment indicate that that card contains an input value such as number of C-130's;

thus, the variables and parameters which represent inputs for a simulation run are flagged. They also are placed at the beginning of the simulation model in groups for further ease in locating and changing. This is done by using INITIAL commands (they are not blocks) which in some cases added extra length to BAGSIM.

When a symbolic address name was used, an attempt was made to have it describe the routine it represented. Examples include:

HLSC2	the initial H means a helo action the final 2 means Helo2
GTS1	to to scene (in Helo1 routine)
IHLD	initialize the amount of HLD's available
WAIT	wait
CCREW	change C-130 aircrew
BFILL	bag filling routine
SMSG	send a message

and so forth. In some instances there seemed little value to having the symbolic name mean anything so multiple letters such as AAA1 were used. This happened most often within a routine for which the symbolic name had sufficiently identified the routine (AAA1 follows HGSC1 for example).

Restrictions on BAGSIM

Certain of the input variables and parameters were constrained in the range of values they could take to meet the following limitations:

- GPSS required a fixed constant
- ADAPTS fixed the possible range
- A large amount of computer space would be required but it would be normally unused.

The amount of E pkgs was limited to twenty (from all sources) to meet the first limitation. That there can be only two types of Helos is an illustration of the second type of limitation. That there can be only fifteen C-130's is an example of the third limitation. These will be considered at length in the detailed description of the model in Chapter 3.

BAGSIM will show extra time consumed in delivering the salvage team from New York City to an incident at NYC. This results from having a C-130, the EC-130 for example, go to NYC to pick up the salvage team and then deliver the team to the air station (HP1) nearest to the scene. This C-130 serves no other function and while it would be necessary for delivery of the team to a location distant from NYC, it is redundant in this case. The time for the C-130 to travel from ECAS to NYC can be changed to zero and the C-130 is then effectively removed from the problem.

The standard GPSS report generator was used in lieu of developing a specific and more descriptive report generator. As a result the user must interpret the results of a simulation run. The reader is referred to Chapter 3 for specific information. This is done since the GPSS report generator presents all the desired data without requiring a single card for control of output while the GPSS commands required for a full but better formatted and more descriptive output requires over 1,000 cards. This

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disadvantage clearly outweighs the advantage of a more legible output. So while the input for BAGSIM was made easier, the output must be interpreted. Particular care must be taken when looking at the STORAGE statistics since some storages are defined empty initially and others are defined full initially while the standard output is based upon all being defined empty initially; e.g., STORAGE HLD is defined full initially so a utilization of 1.0 means it was never used in lieu of meaning it was always used!

Verification of BAGSIM

Any model must be verified in order that its output can be used with confidence. In the case of BAGSIM verification was done by making comparative runs against the ADAPTS problem solutions by PERT/CPM techniques. The results of these comparisons verified the model; see table 2 through 5. The PERT/CPM techniques used a sequencing of events and time required for each event based upon prototype tests and were themselves edited and changed to prevent such occurrances as helicopters arriving on scene two hours before they were needed.

These four verification runs were done for an incident postulated at the Delaware Bay Entrance and with different resources. Verification runs were not done for other locations but the results from the different methods agreed when the differences in resources are considered. For example on the Florida Straits, run FSA was a BAGSIM run with five C-130's, two C-130 loaders and four E pkgs while run DA9 was a PERT run with five C-130's, five C-130 loaders and three E pkgs. The result of the former was 22 bags filled in 24 hours while the result of the latter was 21 bags filled in 24 hours. For Norfolk, runs AA5 by PERT and NFA by BAGSIM ended with 35 and 36 bags filled in 24 hours. Both used five C-130's and four E pkgs but the number of loaders varied and the method of delivering the E pkgs varied.

Although BAGSIM is verified, it should be updated when new parameters are established for ADAPTS equipment. For example, if subsequent experience shows that the time to drop a package out of a C-130 is 15 minutes plus or minus five minutes instead of the flat ten minutes given in the model, the model should be changed and run several times with different random number seeds comparing its results to the actual ADAPTS deployment. Such a change

TABLE 2

Comparison of Run BET Results
Using BAGSIM with PERT/CPM Method

EVENT	BAGSIM TIME	PERT TIME	% DIFF.*
Last E pkg set up	557	539	3.34
1st C-130 returns ECAS	241	239	0.84
1st Bag Dropped	204	202	0.99
1st Bag Filled	395	380	3.95
2nd Bag Filled	555	553	0.36
3rd Bag Filled	676	671	0.74
4th Bag Filled	678	674	0.59
5th Bag Filled	797	792	0.63
10th Bag Filled	1041	1037	0.38
11th Bag Filled	1160	1155	0.43
12th Bag Filled	1162	1158	0.34
18th Bag Filled	1525	1521	0.26
19th Bag Filled	1644	1639	0.30
20th Bag Filled	1646	1642	0.24

*Computed from $\frac{\text{100 times (larger minus smaller time)}}{\text{PERT time}}$

TABLE 3

Comparison of Run 3P3 Results
Using BAGSIM with PERT/CPM Method

EVENT	BAGSIM TIME	PERT TIME	% DIFF.
Last E pkg Set up	605	604	0.16
1st C-130 returns to ECAS	241	239	0.84
1st Bag Dropped	204	202	0.99
1st Bag Filled	416	408	1.96
2nd Bag Filled	582	581	0.17
3rd Bag Filled	726	725	0.14
4th Bag Filled	737	746	1.21
5th Bag Filled	870	869	0.12
10th Bag Filled	1169	1178	0.76
11th Bag Filled	1302	1301	0.08
12th Bag Filled	1313	1322	0.68
18th Bag Filled	1745	1754	0.51
19th Bag Filled	1878	1877	0.05
20th Bag Filled	1889	1898	0.47

TABLE 4

Comparison of Run AAF Results
Using BAGSIM with PERT/CPM Method

EVENT	BAGSIM TIME	PERT TIME	% DIFF.
Last E pkg Set up	845	858	1.52
1st C-130 returns to ECAS	241	239	0.84
1st Bag Dropped	204	202	0.99
1st Bag Filled	416	408	1.96
2nd Bag Filled	582	581	0.17
3rd Bag Filled	726	725	0.14
4th Bag Filled	737	736	0.14
5th Bag Filled	870	869	0.12
10th Bag Filled	1182	1181	0.08
11th Bag Filled	1206	1205	0.08
12th Bag Filled	1302	1301	0.08
13th Bag Filled	1326	1325	0.08
14th Bag Filled	1422	1421	0.07
15th Bag Filled	1446	1445	0.07

TABLE 5

Comparison of Run DBE Results
Using BAGSIM with PERT/CPM Method

EVENT	BAGSIM TIME	PERT TIME	% DIFF.
List E Pkg Set up	485	490	1.02
1st C-130 Returns to ECAS	241	239	0.84
1st Bag Dropped	204	202	0.99
1st Bag Filled	416	403	3.22
2nd Bag Filled	602	601	0.17
3rd Bag Filled	798	798	zero
4th Bag Filled	808	808	zero
5th Bag Filled	1019	1015	0.39
10th Bag Filled	1461	1459*	0.14
11th Bag Filled	1662	1666*	0.24
12th Bag Filled	1672	1676*	0.24
13th Bag Filled	1883	1883*	zero
14th Bag Filled	1893	1893*	zero

*Adjusted to correct for difference in C-130 refueling.

may require an adjustment to the time a helo stays on scene (in BAGSIM) before asking what work is there for a helo.

CHAPTER 3

DETAILED DESCRIPTION OF BAGSIM

Inputs Required

The following are the input numbers needed to run the model. They are discussed here in the same order they appear in the computer card deck.

•LDROO is the number of C-130 loaders, this storage value can be any integer from 1 to 4,294,967,295. For practical reasons it should be less than or equal to the number of C-130's.

•Halfword Matrix 1, MH1, describes the C-130 delivered E pkgs. There must be an initial value card for each C-130 delivered E pkg. See Appendix E for a description of this matrix. A sample initial value card would be: INITIAL MH1(2,1),3 which means place 3 (trip number) into halfword matrix 1 in position row 2 (second E pkg delivered by this C-130) column 1 (first C-130). These must all be positive integers greater than zero. The row number cannot exceed 3, the column number cannot exceed 15.

•Halfword Savevalue 22, XH22, contains the number of extra C-130 aircrews. If there are three C-130's and five aircrews, place 5-3=2 into XH22. This must be a positive integer or zero. (Halfword save values can be any number within ± 32767 in GPSS/360 but BAGSIM places further restrictions.)

•XH23 contains the C-130 aircrew endurance in minutes, that is, the length of time a crew is allowed to use a C-130 before it must rest. This must be a positive integer.

•XH3 contains the number of C-130's in this run. It must be an integer from 1 to 15 inclusive.

•XH2 contains the number of four man salvage teams used in the run. It is generally set equal to the total number of pumps used in the run. The only effect of salvage teams in BAGSIM is to tie up C-130's and Helos for delivery of the teams to the scene. The actual need for a given number of men is not determined. This number must be a positive integer.

•XH40 contains the distance in nautical miles from Brooklyn Air Station, BAS, to the air station nearest to the scene, HP1. It must be greater than or equal to zero (but less than 32,767).

•XH20 contains the distance in nautical miles from HP2 to HP1 where HP1 is the air station nearest to the scene and HP2 is the next nearest air station. This distance is greater than or equal to zero.

•The distances to the scene are in the next four initializing cards:

Halfword Savevalue	Distance Involved
XH5	from ECAS to scene
XH6	from ECAS to HP1
XH7	from HP1 to scene
XH8	from HP2 to scene

Each of these distances must be greater than or equal to zero.

•HX16 and XH17 contain the prepositioned E pkgs at HP1 and HP2 respectively. These are integers greater than or equal to zero.

•XH41, XH42, and XH43 are the helicopter type designators. They must contain either a 3 or a 52 to specify the type of helicopter. XH41 represents the first helicopter, it is the helo immediately available at HP1. XH42 represents the second helicopter, it is the helo immediately available at HP2. XH43 represents the third helicopter, it is the backup helo at HP1 Any combination of the helo types (3 or 52) with helo availability (Helo1 used or not, Helo2 used or not, Helo3 used with variable standby or not used) is allowed.

•XH50 is the call up time for the backup helo at HP1; it is a positive integer or zero. BAGSIM assumes that, after HP1 has been notified to provide helos, one minute is used to call the helo on immediate standby and then XH50 is the time lapse before Helo3 is ready to do work.

•XH51 through XH55 are the standby times for the first through fifteenth C-130 respectively. All these times are measured from the time ECAS is first notified and they are generally set to:

Halfword Savevalue	Value
XH51	0
XH52-XH55	60 minutes
XH56-XH65	300 minutes

These are changeable to any realistic standby time subject to the following restrictions:

a. greater than or equal to zero

b. integers representing minutes

c. Sorted by size with the smallest first to the largest last. This is necessary since the C-130's are identified in the order they come off standby.

•XH14 represents the time needed to install rails on the C-130 if rails are not installed. It is generally set to 15 minutes to represent the final sections of -4A rails but it can be any positive integer.

•XH15 represents the time needed to load a C-130. It can be any positive integer greater than zero. It is assumed to be constant for all loads and C-130's (after the rails are installed). With the 25K loader, this value is expected to be 90 minutes. (The point made earlier that any constant value time delay, such as this 90 minute delay, can be represented as a mean ± a curve applies, should experience warrant using probabilities or variables, the change is simple to make.)

The preceeding inputs are all grouped before the GPSS block statements in a section of definition statements. Following them are the mathematical statements that define the variables and then the model. Some input values are more effeciently placed at the head of the model after the GENERATE block.

•Logic switches 1, 2, 3, 4, 5, and 10 are used to denote either-or situations:

Logic Switch	Meanings S=set; R=reset*
1	S = Helo1 available and used
	R = Helo1 not used
2	S = Helo2 is used at HP2 then HP1
	R = Helo2 is not used at HP1 but it can be used at HP2 if XH17 is greater than zero
3	S = Helo3 available and used
	R = Helo3 not used
4	S = Manifolds are placed on the pump discharges
	R = No manifolds
5	S = Helos tow packages in the water
	R = Helos do not tow packages but they deliver the end of the tow line
10	S = Salvage teams at NYC
	R = Salvage teams at ECAS

*All logic switches are initially reset.

These commands are placed in the first 10 blocks.

•The final input is the TEST G block (block 25) between symbolic addresses PLANE and DTEAM. It is flagged with three asterisks and is the number of C-130's that have rails installed. The assumption is that the C-130's with rails installed are used first. It can be any positive integer; it is presently set equal to one since the present plans are that only the immediately available C-130 at ECAS will have rails installed at all times.

Outputs

BAGSIM is designed to give an extended output when 10 bags have been filled and a standard output when 40 bags have been filled. Some conditions that can occur, such as insufficient flight time for the crews will terminate the problem early with standard output. These considerations have been placed into the model with indicators to aid in determining the reason for early termination.

Halfword matrix 7 is used to log messages sent by the C-130's to HP1 and HP2 and Helos at the scene. This matrix is defined to hold thirty messages; once it is filled, it is printed and zeroed for the next thirty messages.

The extended output that is printed after 10 bags are filled includes first, the current time in minutes and the block status. For each block the current contents (number of transactions) and the total entries are tabulated. This is useful in determining the location of aircraft at that time.

Second, the current events chain is printed. It lists the transactions and their parameters that at this time are being moved by the simulation. This is an extended output used in debugging and determining values of variables. It is interpreted using reference 1.

Third, the Future Events Chain is printed. This is similar to the current events chain but it lists the transactions that are waiting a future time before they are moved by the simulation.

Fourth, the facility statistics are printed. There are four facilities used and they are:

Facility Name	Represents
1	Helo1 usage
2	Helo2 usage
3	Helo3 usage
LOADH	A throttling device to prevent loading more than helo at a time with E pkgs.

If a numbered facility is seized, that means the helo is doing work for the seizing transaction; if it is preempted by a C-130, it means that an E pkg is being delivered; and if it is preempted by the helo, it means that the helo has left the scene. (1- Average utilization) represents the % time helos are available for work and are not working. The average time per transaction is the average of time at scene and working plus time away from scene. It is relatively meaningless. The preempting transaction is the transaction that represents the helo or a C-130 delivering an E pkg. The priorities for seizing or preempting are:

Priority Number	Transaction Representing	Action
1	Bags	Can seize only
3	C-130's	Can preempt bags
5	Helos	Preempts C-130's and bags

By using the number of the preempting or seizing transaction, the current events chain and the future event chain, the reader can determine exactly what is happening at the time of the printout.

Fifth, the logic switch status printing is given. It is a listing of logic switches that are set. The meaning of having a particular logic switch set or reset is given in Appendix F. The logic switches in the 200's are used to flag time delays that are computed to a negative value. Most of these terminate the problem early.

Sixth, the storage statistics are printed. These are:

Name	Use
DZONE	to limit the number of C-130's in the drop zone to two since more than two C-130's dropping packages at a given time would interfere with each other and present a risk of collision.
HAUL	to define the number of HLD's at the scene in this run. Its statistics are useful for debugging only since it is filled initially.

EPKG to define the number of pumps at the scene in this run regardless of source. Its statistics are useful for debugging only since it is filled initially, emptied as pumps are set up, and refilled when pumps are in use.

LDROO the number of C-130 loaders in this run. Its statistics are particularly valuable since loaders are so costly and necessary.

Seventh, the Halfword Savevalues, XH_n, (the contents of which are not equal to zero) are printed along with the value of the contents. The definitions of these halfword savevalues are given in Appendix D. Since fullword savevalues are not used by BAGSIM, they are not printed.

Eighth, the queue statistics are printed. These are standard queueing (waiting line) parameters and are useful in determining the causes of delays and their remedies. Six queues have been defined, they are:

Name	Server	Description
WLDR	C-130 loaders	This is the queue for C-130's waiting to be loaded.
WDZ	Scene	This is the queue for C-130's waiting near the scene to drop their load.
WHELO	Helos	This is the queue for C-130's waiting at the scene for a helo when an E pkg is in its load.
WCPTR	Helos	This is the queue for bags in the water waiting for a helo to deliver messenger (or to tow).
WEPKG	Pumps	This is the queue for bags after positioning by HLD (or helo) waiting for a pump to become available.

Other queues could have been defined (such as waits for HLD's) but they are considered to be minor so while the wait actually occurs in BAGSIM it is not recorded.

Ninth, a tabular presentation of helo on scene time is printed. For 15 minute intervals, the number of helo stays on scene is tabulated along with percentages of total, cumulative percentages, the mean, standard deviation, and sum. It is labeled OSTMH.

Tenth, tables are presented for four of the queues, they are:

Table	Queue	Size of Interval
WTLDR	WLDR	15
WTDZ	WDZ	10
WTHH	WHELO	5
WTCP	WCPTR	5

These tables are identical in format to the table previously described.

Eleventh, the Matrices are printed out. These are printed one to a page, and are identified by number only. The rows and columns are numbered. The meanings assigned to the matrices and their rows and columns are described in Appendix E. Matrix 6 was not entered into BAGSIM.

Number	Use
1	to input the C-130 delivery schedule for pumps.
2	to record each time each C-130 returns to ECAS
3	to record when a pump first is ready to pump and which aircraft delivered it.
4	information on filled bags
5	to record each time each C-130 begins loading
7	to record the messages and the action taken
8	to record the helicopter trips.

The standard output that is printed at the end of the simulation run is the same as the extended output except the current events chain and the future events chain are not printed.

Whenever an early termination is necessary a TRACE block is passed which causes the terminating transaction to the printed just before the final output. This helps in determining more of the facts of the problem.

Far more output could be specified but in normal simulation runs it is unnecessary. For example standard output could be specified when each

bag is filled or it could be specified when any specific event occurs. It may be necessary to know where every C-130 and helicopter is after 9 1/2 hours. Standard output can be called by a simple clock routine at 9 1/2 hours or every 9 1/2 hours instead of, or in addition to, output after 10 and 40 bags are filled. It may be desirable to know where all helos are when a C-130 carrying a pump in its load is 5 minutes from a drop. This can be specified as an extended output or by printing only the current event chain end the future event chain. Additional queues could be defined for more waiting time information Practically any question about the operational deployment of ADAPTS can be asked except what is the best number of ________.

GPSS does not seek an optimal. It is similar to an equation. For given inputs, an output is presented. In a deterministic situation the same output is given each time the same inputs are used. In a stochastic situation different possible outputs are given each time the same inputs are used with different random number seeds. In BAGSIM there are 60 blocks that could have been defined with stochastic parameters but were defined with average values. Any of all of them can be changed to stochastic variables should experience warrant. If many of them are, a large number of runs would be needed to define:

a. the most likely results and

b. the possible range of results.

Program Description

BAGSIM is listed in Appendix A. The computer listing breaks down readily into:

1. the Job Control Language for the IBM 360 computer. These cards have // in the first two columns. They specify the use of GPSS-360V2 and the file sizes and allocations. The total region needed is near 170K of main core and the problem runs for 90 seconds on an IBM 360/65.

2. definitions; between the SIMULATE card and the GENERATE card are the cards that define the storages, tables, matrices, variables, and boolean variables. Included in this section are the cards that assign initial values to the matrices and Savevalues which require initial values. Some of the initial values are for counters and others are inputs.

3. the model which begins with the GENERATE card and ends with the last block which is the TRANSFER, GOHP1 card.

4. three GPSS control cards which specify starting the simulation run, the desired output, and the ending of the run.

The model consists of many well defined portions. The first portion from the comment card "AIRCRAFT CALL UP ROUTINE" includes the GENERATE card which makes the first transaction This transaction initializes the storages HAUL and EPKG. It splits to form the C-130's used in the run and places them through the delays of call up and rail installation before sending them to the Delivery Routine. If the Salvage teams are at NYC, this transaction splits off an aircraft to go from ECAS to BAS, pick up the teams, and deliver them to HP1. It also determines which helos are used and splits transactions to the Helo Routines. The "HELO #1 ROUTINE" is next in sequence. It assigns to the transaction that represents Helo1 the trip

times and maximum permissible on scene times. This transaction will now be called Helol. It waits for the Salvage Teams (S.T.) unless the S.T. will be delivered after Helo3 is ready. In this latter case Helo3 waits for the salvage team and Helol makes one pump trip and then waits for salvage teams.

The normal sequence for Helol is:

1. deliver one S.T.,
2. deliver an E pkg if there are any pumps at HPl,
3. deliver the remaining S.T.,
4. deliver the remaining pumps,
5. make empty trips for the rest of the on scene work.

Whenever Helol goes to the scene it stays for a minimum of eleven minutes and then asks:

1. Is my endurance ended?
2. Is work in progress?
3. What work is coming?

If work is not in progress and a C-130 is coming the helo either waits for it or goes back to HPl and refuels and then comes back to scene in time for its arrival. Whenever Helol returns from the scene it asks:

1. Has an E pkg been delivered? If no, deliver one E pkg from HPl.
2. Have all salvage teams been delivered? If no, deliver them.
3. Are there any more E pkgs at HPl? If yes, deliver them.
4. Can this helo wait before leaving for the scene? If yes, wait and check messages; if no, go to scene.

The messages sent by C-130's are checked either at the scene or at HPl. When the helo takes a message it computes when it is needed and schedules itself to be at the scene when the C-130 arrives. It also indicates on the message file (MH7) that it received the message.

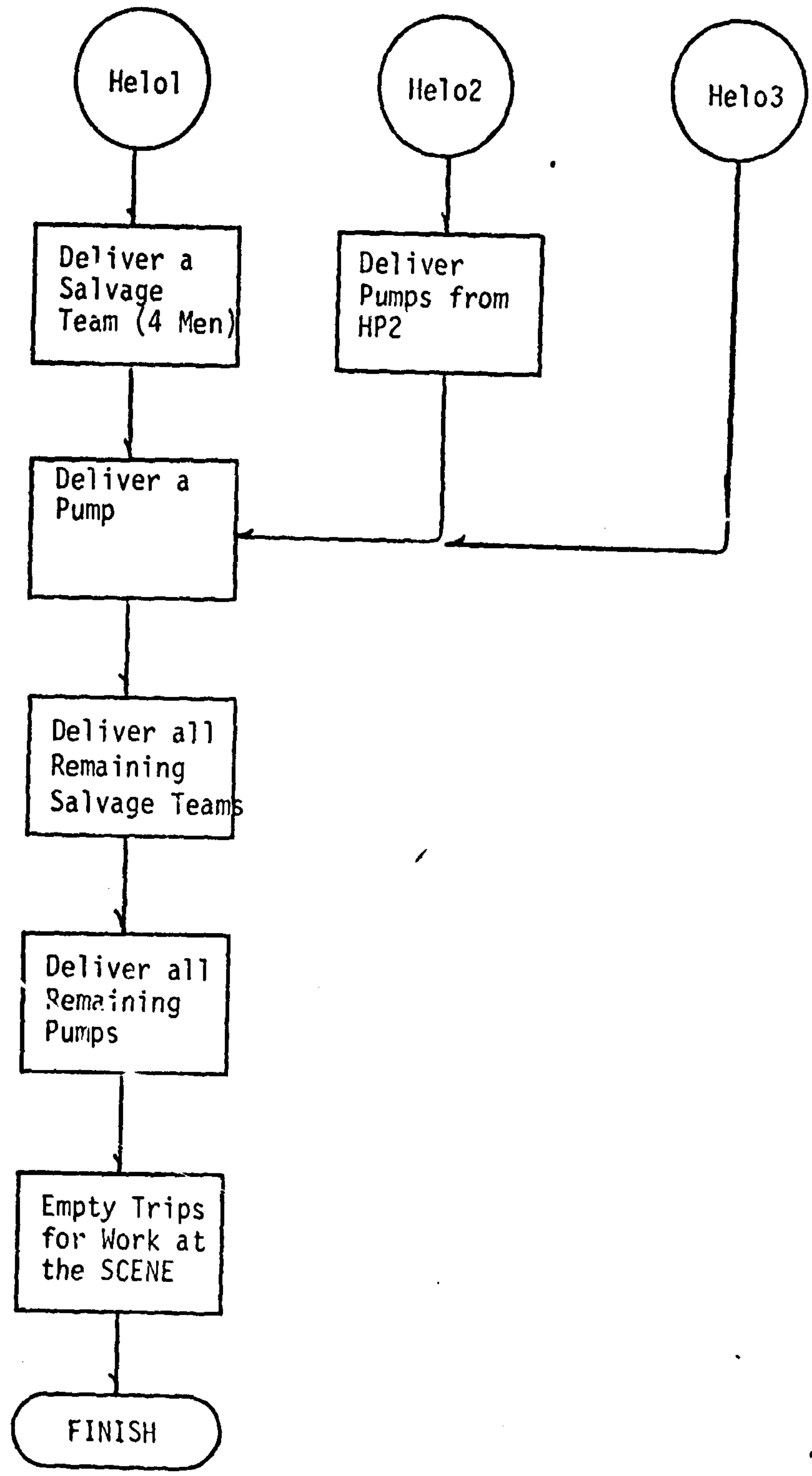

Figure 2. Work Strategy Followed by Helicopters in BAGSIM.

The situation that a C-130 delivering an E pkg has an available helo but the helo has to leave to refuel before the HLD has been delivered can arise. The need to refuel was given preemptive priority over all tasks performed by helo's. Whenever such a preemption occurs, the C-130 is removed by GPSS from its normal delivery routine and placed into the RES2 subroutine. There the status of the load is determined. If no packages have been dropped, the C-130 is reset into the drop zone waiting for any helo. If the E pkg had been dropped but not the bag pkg, the bag pkg is dropped and the C-130 returns to ECAS. If both pkgs were dropped, the C-130 had already begun its return trip and the preempted transaction actually represented the time needed to tow in an E pkg. It is no longer needed since it can be hauled in when no helo is available so it is terminated.

The E Package Set Up Routine describes the process of setting up E pkgs from the time they hit the water until they are ready for use. The HLD is delivered by the same helo that stood by during the drop, then this routine tells the delivery routine to release the helo. The HLD is set up and the count in storage HAUL is decreased by one to signify an unused HLD. If there is an unused HLD, it is used to haul in the E pkg. (When helo's can tow, the HLD is used to finish the hauling and lifting.) If no HLD is free, the E pkg queues for HLD's but at the head of the line before bags (priority queue without preemption). The E pkg is hauled in, lifted aboard, and the HLD is released. Helo delivered E pkgs are inserted into the routine at this point. E pkgs are then set up and test run. The time each E pkg becomes ready is logged and the count in storage EPG is decreased by one to allow the use of the ready E pkg.

The Bag Filling Routine begins when the bag pkgs hit the water. They are assumed to anchor and open as planned. The bags wait for helos to

deliver their messengers (or to tow if that option is picked). If a bag is preempted by a C-130 for the use of a helo, the bag is reset into the routine at a point and time where it would be if it had not been preempted. This recognizes the fact that a helo can standby for a C-130 and continue other work. Whenever a bag is preempted by the refueling needs of a helo, the work done by a helo is lost and the bag is reset into the helo waiting queue titled WCPTR. Once the hauling process is completed, it queues for E pkgs. When an E pkg is available, it is connected and the bag is filled. After filling, the bag data is logged into MH4 and the bag drops from the problem.

The balance of the model includes the message subroutine, the preemption resetting subroutines, and the bomb-out subroutines. Their purposes have already been described.

Limitations of the Model

The model is currently limited to three helicopters. Each may be an HH-3F or an HH-52A; no other type is allowed.

Only C-130 aircraft are considered for air delivery of bags and they come from only one air station. The C-130's can carry two bag packages or one bag package and one equipment package. When an equipment package is carried, it is dropped first. C-130 refueling is assumed to be done as necessary during loading operations.

The greatest limitation on the use of the model is that it is based upon the prototype ADAPTS equipment and bag. If these are changed, the model must be changed. The prototype characteristics are listed in Table 6. Any changes in these must be evaluated for the effect of the change on the numbers that can be delivered by C-130 and helicopter, for the effect of the change upon the duration of the tasks, and for the effect of the change upon the salvage team composition.

Helo2 is the ready helicopter (on immediate standby) at HP2. Since it has to go farther to reach the scene there will be occasions that, when Helo2 is used, an HH-52A cannot be used but an HH-3F can be used. Whenever Helo2 is called up, it checks to see if it has enough on scene endurance (carrying E pkgs from HP2). If it does, the problem continues, if it does not, and it is an HH-52A, it is changed to an HH-3F and the check is made again. If it is an HH-3F and it does not have enough endurance, it sets logic switch 236, prints the status of logic switches and checks whether or not it is supposed to go to HP1. If it is to go to HP1 (logic switch 2 is set), it goes there, stopping to refuel at arbitrary points on the way. The arbitrary points represent commercial airports that undoubtedly exist but may not be in the desired minimum time path between HP1 and HP2. This approximation may introduce some error in the time Helo2 arrives at HP1; generally the error will have little or no affect on bag filling time, hence, it is ignored for all purposes except for scheduling that trip. When Helo2 arrives at HP1, it follows the normal sequence given above for Helo1 starting at step 2.

If Helo2 has sufficient endurance to deliver E pkgs from HP2 to the scene and if there are E pkgs for it to deliver, it delivers them; it does work at the scene if and only if:

1. A C-130 or a Bag is waiting for a helo (BV4 = 1) and
2. It can stay on scene for 30 minutes.

If these conditions are not met, it delivers the E pkg and returns to HP2. When all E pkgs from HP2 have been delivered, Helo2 checks whether or not it is to go to HP1 as just described. If HElo2 is to continue working at the scene, it is logical for it to use HP1 as its support base since HP1 is by definition closer to the scene.

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Helo3 is the helicopter that backs up Helol at HP1. It's call up period is intially set into XH50 at 60 minutes and it is identified as an input. When Helo3 comes up from standby, it either waits for the S.T. in lieu of Helol and then follows the normal sequence given above for Helol or it follows the normal sequence given above for Helol starting at step 2. Figure 2 is a simple diagram of the strategy followed by the three helicopters.

The Delivery Routine describes the C-130 operations during the deployment of ADAPTS. The C-130's queue at the loaders, load and send a message giving ETA at scene, and go the scene. The C-130's carrying two bag pkgs drop them once they can enter the drop zone and return to ECAS. The C-130's carrying an E pkg and a bag pkg queue for a helicopter. Once a helicopter is available, they drop their loads and return to ECAS. Each time the C-130's return to ECAS the question: "can this crew make another trip?" is asked. If the answer is yes, they continue; if not, they either take another crew and continue or are grounded. When the last C-130 available is grounded, the problem is terminated.

When C-130's are delivering E pkgs, they must have a helo at the scene to pick up the free floating HLD: when bag pkgs are delivered, the C-130's can work independently of the helos. So ·n a C-130 arrives with E pkgs it either waits for a helo to arrive or p..empts the use of a helo at the scene. "Preempt" means that it stops the work the helo was doing and the helo picks up the HLD before continuing with the other work. Actual stoppage is not necessary for ten minutes so the situation is approximated by having the helo preempted immediately when the C-130 arrives but by sending the preempted bag to the RES4 subroutine where the work is finished concurrently with the helo waiting for the E pkg to enter the water.

TABLE 6

PROTOTYPE ADAPTS EQUIPMENT

	DIMENSIONS	WEIGHT
Oil Storage Container with Hose and Fittings	Folded 5'8" x 7'0" x 6'2"	8,583 lbs.
Capacity 140,000 gallons	Filled 140' x 30' x 6'	500 tons
Oil Storage Container Module (including flotation, side plates, and bindings)	7'0" x 7'4" x 8'0"	10,512 lbs.
Diesel Engine Module (including enclosure and flotation)	3'4" x 3'7" x 4'0"	1,150 lbs.
Pump Module, rated 1000 gpm @ 60 ft. head (including enclosures, pump, flotation, and hydraulic hoses)	2'4" x 2'4" x 6'10"	946 lbs.
Pump alone	8" diameter x 6'10"	455 lbs.
Flexible Seal Drum Fuel Container (55 gallons)	Filled 2' diameter x 2'10"	450 lbs.
HLD Module (including flotation and adjustable strap)	2'1" diameter x 10' 3"	278 lbs.

APPENDIX A

PROGRAM LISTING

```
*****************************************************
*              GPSS/360 ADAPTS PROBLEM              *
*                     BAG SIM                       *
*****************************************************

* SCENE IS FLORIDA STRAITS
*** MEANS INPUT
* 1ST HELO PORT(HP1) IS MAS
* 2ND HELO PORT'HP2) IS SPAS

* ASSUMPTIONS:
*       1. IF THE SALVAGE TEAM IS BASED IN NYC, A SPARE C130 IS USED
*          TO DELIVER IT TO HP1. NOTE THIS ASSUMPTION IS IMPROPER
*          FOR ANY SCENE NEAR NYC!
*       2. CMAS AND THE MUNICIPAL AIRPORT ARE CLOSE ENOUGH TO EACH
*          OTHER THAT THEY CAN BE CONSIDERED IDENTICAL FOR THE
*          PURPOSES OF THIS PROBLEM!
* THIS SIMULATION RUNS UNDER THE ASSUMPTION THAT THE 1ST HELO IS READY
* IN 1 MINUTE AND THAT THE 3RD HELO IS READY 60 MINUTES AFTER THE FIRS
* IS CALLED; THE 2ND HELO COMES FROM A NEARBY AIR STATION IF USED.
 DZONE STORAGE     2      CAN HAVE 2 C130'S DROPPING PKGS AT A TIME
 HAUL  STORAGE     20                     CAN HAVE UP TO 20 HLD'S
 EPG   STORAGE     20                     CAN HAVE UP TO 20 E PKGS
 OSTMH TABLE       M1,15,15,25            * ON SCENE TIME OF HELO'S
 WTLDR QTABLE      WLDR,0,15,13
 WTDZ  QTABLE      WDZ,0,10,7
 WTHH  QTABLE      WHELO,0,5,8
 WTCP  QTABLE      WCPTR,0,5,8

 1     MATRIX      H,3,15                 * INPUT MATRIX DELIVER E PKG'S
 2     MATRIX      H,30,15                * OUTPUT C130 RETURN TIMES
 3     MATRIX      H,20,3                 * OUTPUT E PKG'S READY FOR USE
 4     MATRIX      H,40,9                 * OUTPUT BAG PKG DATA
 5     MATRIX      H,30,15                * OUTPUT TIME C130 LOADING BGNS
 7     MATRIX      H,30,6                 * OUTPUT MESSAGE INFORMATION
 8     MATRIX      H,50,6                 * OUTPUT HELO DATA

***********       INPUT DATA
*
 LDR00 STORAGE     5                      *** NUMBER OF C130 LDRS THIS RU
```

```
      INITIAL     MH1(1,1),1               *** NEED ONE CARD PER E PKG
      INITIAL     MH1(1,2),1
      INITIAL     MH1(2,1),3
      INITIAL     MH1(1,4),2
      INITIAL     XH28,1
      INITIAL     XH29,K1
      INITIAL     XH22,5                   *** NUMBER OF EXTRA C130 CREWS
      INITIAL     XH23,480                 *** C130 CREW ENDURANCE
      INITIAL     XH3,5                    *** NUMBER OF C130'S THIS RUN
      INITIAL     XH2,6           *** NUMBER OF 4 MAN SALVAGE TEAMS
      INITIAL     XH40,949                 *** DISTANCE FM BAS TO HP1
      INITIAL     XH20,174                 *** DISTANCE FM HP2 TO HP1
      INITIAL     XH5,772                  *** DISTANCE FM ECAS TO SCENE
      INITIAL     XH6,656                  *** DISTANCE FM ECAS TO HP1
      INITIAL     XH7,118                  *** DISTANCE FM HP1 TO SCENE
      INITIAL     XH8,242                  *** DISTANCE FM HP2 TO SCENE
      INITIAL     XH16,2                   *** # PREPOSITIONED E PKG HP1
      INITIAL     XH17,2                   *** # PREPOSITIONED E PKG HP2
      INITIAL     XH19,1                   COUNTER , HELOS SELECT MSG
      INITIAL     XH41,3                   *** 52=HH52  3=HH3
      INITIAL     XH42,3                   *** 52=HH52  3=HH3
      INITIAL     XH43,3                   *** 52=HH52  3=HH3
      INITIAL     XH50,60                  *** STANDBY TIME HELO3
      INITIAL     XH51,0                   *** STANDBY TIME  1ST C130
      INITIAL     XH52,60                  *** STANDBY TIME  2ND C130
      INITIAL     XH53,60                  *** STANDBY TIME  3RD C130
      INITIAL     XH54,60                  *** STANDBY TIME  4TH C130
      INITIAL     XH55,60                  *** STANDBY TIME  5TH C130
      INITIAL     XH56,300                 *** STANDBY TIME  6TH C130
      INITIAL     XH57,300                 *** STANDBY TIME  7TH C130
      INITIAL     XH58,300                 *** STANDBY TIME  8TH C130
      INITIAL     XH59,300                 *** STANDBY TIME  9TH C130
      INITIAL     XH60,300                 *** STANDBY TIME 10TH C130
      INITIAL     XH61,300                 *** STANDBY TIME 11TH C130
      INITIAL     XH62,300                 *** STANDBY TIME 12TH C130
      INITIAL     XH63,300                 *** STANDBY TIME 13TH C130
      INITIAL     XH64,300                 *** STANDBY TIME 14TH C130
      INITIAL     XH65,300                 *** STANDBY TIME 15TH C130
      INITIAL     XH9,1                    ROW COUNTER FOR MSG MATRIX
      INITIAL     XH14,15                  TIME TO INSTALL RAILS
      INITIAL     XH15,90                  TIME TO LOAD C130

    1 VARIABLE    C1-XH21                  LAPSED TIME SINCE C130 ARRIVED
    2 VARIABLE    XH23+P16-C1-V6-V7-20      CREW TIME LEFT AFTER NEXT TP
    3 VARIABLE    60*XH40/270              * C130 TIME, BAS TO HP1
    4 VARIABLE    60*XH6/270               * C130 TIME,ECAS TO HP1
    5 VARIABLE    10+60*XH7/270            * C130 TIME,HP1 TO SCENE
    6 VARIABLE    60*XH5/270               * C130 TIME,ECAS TO SCENE
    7 VARIABLE    60*XH5/290               * C130 TIME,SCENE TO ECAS
    8 VARIABLE    XH15+V6+C1               TIME C130 ARRIVES AT SCENE
    9 VARIABLE    60*(1-BV1)*XH7/85+60*BV1*XH7/115 * HP1 TO SCENE
```

```
10 VARIABLE   60*(1-BV1)*XH7/95+60*BV1*XH7/125 * SCENE TO HP1
11 VARIABLE   60*(1-BV2)*XH8/85+60*BV2*XH8/115 * HP2 TO SCENE
12 VARIABLE   60*(1-BV2)*XH8/95+60*BV2*XH8/125 * SCENE TO HP2
13 VARIABLE   60*(1-BV3)*XH7/85+60*BV3*XH7/115 * HP1 TO SCENE
14 VARIABLE   60*(1-BV3)*XH7/95+60*BV3*XH7/125 * SCENE TO HP1
15 VARIABLE   50+P2                        FOR ADDRESSING XH*10
16 VARIABLE   C1+P7-11          TIME WHEN C130 MUST REACH SCENE IF
17 VARIABLE   C1+P8-11                     HELO IS TO SERVE IT
18 VARIABLE   C1+P9-11                         "
19 VARIABLE   60*(1-BV2)*XH7/85+60*BV2*XH7/115     HP1 TO SCENE
20 VARIABLE   60*(1-BV2)*XH7/95+60*BV2*XH7/125     SCENE TO HP1
21 VARIABLE   60*(1-BV2)*XH20/85+60*BV2*XH20/115    HP2 TO HP1
22 VARIABLE   150+158*BV1-V9-V10      TIME ON SCENE IF S TEAM CRD
23 VARIABLE   P5+P6+P10     TIME FOR HELO TO RETURN,REFUEL,&SORTEE
24 VARIABLE   3*XH16                       0 = NO E PKGS TO CARRY HP1
25 VARIABLE   3*XH17                       0 = NO E PKG TO CARRY FM HP2
26 VARIABLE   270+82*BV1-V9-V10  TIME ON SCENE IF EMPTY
27 VARIABLE   120+62*BV1-V9-V10  TIME ON SCENE IF E PKG CRD
28 VARIABLE   150+158*BV3-V13-V14   HELO3 ON SCENE TIME IF SAL. T.
29 VARIABLE   270+82*BV3-V13-V14    HELO3 ON SCENE TIME IF EMPTY
30 VARIABLE   120+62*BV3-V13-V14    HELO3 ON SCENE TIME IF E PKG
31 VARIABLE   20+10*BV1                    * TIME TO REFUEL HELO #1
32 VARIABLE   20+10*BV2                    * TIME TO REFUEL HELO #2
33 VARIABLE   20+10*BV3                    * TIME TO REFUEL HELO #3
34 VARIABLE   150+158*BV2-V19-V20  HELO2 ON SCENE TIME IF S.T,HP1
35 VARIABLE   270+82*BV2-V19-V20   HELO2 ON SCENE TIME,EMPTY,HP1
36 VARIABLE   120+62*BV2-V11-V12   HELO2 ON SCENE TIME IF E PKG,HP
37 VARIABLE   120+62*BV2-V19-V20   HELO2 ON SCENE TIME IF E PKG,HP
38 VARIABLE   270+82*BV2                   ENDURANCE OF HELO2

 1 BVARIABLE  XH41'L'4        HELO1: 0 = HH52, 1 = HH3
 2 BVARIABLE  XH42'L'4        HELO2: 0 = HH52, 1 = HH3
 3 BVARIABLE  XH43'L'4        HELO3: 0 = HH52, 1 = HH3
 4 BVARIABLE  Q$WCPTR+Q$WHELO             =1 IF SOMETHING IS AWAITING HEL
 5 BVARIABLE  FU*12+BV4                   =1    HELO IN USE
 6 BVARIABLE  P2'G'0*P2'L'4*P2'NE'P12            1=OTHER HELO

**********                                AIRCRAFT CALL UP ROUTINE
*
   GENERATE   11,,,1,5,16,H               * START PROBLEM;CG NOTIFIED
   SAVEVALUE  24,XH3,H
   SAVEVALUE  26,V24,H
   SAVEVALUE  27,V25,H
   LOGIC S    1                           *** S = HELO #1 AVAILABLE
   LOGIC S    2                           *** R = HELO #2 NOT USED AT HP1
   LOGIC S    3                           *** R = HELO #3 NOT USED
   LOGIC S    4                 *** S = MANIFOLDS; R = NO MANIFOLDS
   LOGIC R    5                 *** S = HELOS TOW; R = TOWING NOT ALLOWED
   LOGIC R    10                          *** S=SALVAGE TEAMS BASED @ NYC
```

```
      SPLIT       20,IEPKG
      SPLIT       20,IHLD
      ADVANCE     2                      * DECIDE TO RESP.
      SPLIT       1,IHCFT
      GATE LR     10,DTEAM               IS TEAM IN NYC?
CCAC  TEST G      XH3,15,PLANE
      SAVEVALUE   3,15,H                 15 IS MAX # C130'S ALLOWED
PLANE SAVEVALUE   11+,K1,H               INCREMENT FOR C130
      ASSIGN      2,XH11                 LOG C130 NUMBER
      TEST LE     P2,XH3,FINIS           REACHED # C130'S IN PROBLEM
      ASSIGN      10,V15                 LABEL WHICH XH TO USE
      PRIORITY    3                      C130 PRIORITY
      SPLIT       1,PLANE                PREPARE NEXT C130
      ADVANCE     XH*10                  STANDBY TIME
      SAVEVALUE   P10,1,H                INITIALIZE FOR EPKG1 ROUTINE
      TEST G      P2,1,TWOP          *** NUMBER OF C130'S WITH RAILS INSTALL
      ADVANCE     XH14                   INSTALL RAILS
TWOP  ASSIGN      16,C1                  LOG TIME C130 BECOMES AVAILABLE
      TRANSFER    ,ONEP                  C130 READY TO LOAD
DTEAM SPLIT       1,CCAC                 SALVAGE TEAM AT NYC SUBROUTINE
      ADVANCE     80                     GO TO BAS & LOAD TEAM
      ADVANCE     V3                     GO TO HP1
      LOGIC S     52                     TRANSFER TEAM TO HELO
      SAVEVALUE   18,C1,H                LOG TIME
FINIS TERMINATE   0
IEPKG ENTER       EPG                    * INITIALIZE,NO E PKG AV.
      GATE LS     35                     * E PKG SET UP YET?
      LOGIC R     35
      LEAVE       EPG                    * ONE E PKG HAS BEEN SET UP
      TERMINATE   0
IHLD  ENTER       HAUL                   * INITIALIZE,NO HLD AVA.
      GATE LS     34                     * HLD SET UP YET?
      LOGIC R     34
      LEAVE       HAUL                   * ONE HLD HAS BEEN SET UP
      TERMINATE   0
IHCFT PREEMPT     1
      ASSIGN      16,1                   MSG TO TEST
      SPLIT       1,HELO2                * START 2ND HELO SUBROUTINE
      ADVANCE     1                      * CALL UP 1ST HELO
      SPLIT       1,HELO3                * START 3RD HELO SUBROUTINE

************                             HELO #1 ROUTINE
*
      GATE LS     1,FINIS                * IF R, 1ST HELO NOT USED
      ASSIGN      5,V9                   HELO1, HP1 TO SCENE TIME
      ASSIGN      6,V10                  HELO1, SCENE TO HP1 TIME
      ASSIGN      7,V22                  HELO1, ON SCENE ENDURANCE, S T
      ASSIGN      8,V26                  HELO1, ON SCENE ENDURANCE, EMPT
```

```
        ASSIGN      9,V27              HELO1, ON SCENE ENDURANCE, E PI
        ASSIGN      10,V31             HELO1, REFUEL TIME
        ASSIGN      12,1               THIS·IS HELO1
        TEST LE     MH7(1,3),XH50,GOERL IF C130 ARRIVES AFTER HELO3,GO
WAIT    GATE LS     52                 * WAIT FOR SALVAGE TEAM
HELO1   ADVANCE     2                  * SALVAGE TEAM BOARD HELO1
        TEST G      P7,11,BOV22        IF V22<11 BOMBOUT
        ASSIGN      11,1               LOG HELO CARRIED SALVAGE TEAM
        SAVEVALUE   2-,1,H             ONE TEAM LESS TO LOAD
        ASSIGN      13,V16    LOG TIME C130 MUST ARRIVE SO HELO CAN WORI
HGSC1   SAVEVALUE   31+,1,H            LOG HELO TAKE OFF
        ASSIGN      1,XH31
        MSAVEVALUE  8,P1,2,C1,H
        MSAVEVALUE  8,P1,6,P11,H       LOG LOAD CARRIED BY HELO
        MSAVEVALUE  8,P1,1,P12,H       LOG WHICH HELO
        ADVANCE     P5                 GO TO SCENE
        MSAVEVALUE  8,P1,3,C1,H        LOG TIME ARRIVE AT SCENE
        MARK                           RESET MARK TIME, HELO AT SCENE
        ASSIGN      14,P13             LOG TIME WHEN
        ASSIGN      14+,11                HELO MUST LEAVE SCENE
        TEST E      Q$WHELO,0,FFF1     IS A C130 WAITING FOR A HELO?
        TEST NE     P11,0,FFF1         IS HELO MAKING AN EMPTY TRIP?
        ADVANCE     6                  UNLOAD HELO
        TEST E      Q$WHELO,0,FFF1     IS A C130 WAITING FOR A HELO?
        ADVANCE     4
FFF1    RETURN      P12                HELO READY FOR OTHER WORK
        LOGIC R     6
        LOGIC R     7
AAA1    ADVANCE     11                 WORK 11 MINUTES
        TEST G      P14,C1,HLSC1       HAS HELO REACHED END OF ENDURA
        TEST E      BV5,0,AAA1         IS HELO IN USE?
        TEST G      V1,20,AAA1     WAS A C130 HERE IN THE LAST 20 MIN?
AAA2    ASSIGN      15,MH7(P16,3)      TAKE MSG IF
        TEST G      P15,0,HLSC1           IT EXISTS
        TEST G      P15,C1,AAA3        HAS THIS MSG EXPIRED?
        ASSIGN      2,MH7(P16,5)       TAKE STATUS OF MSG
        TEST E      BV6,0,BBB1         DID OTHER HELO TAKE MSG?
        TEST L      P15,P13,BBB1       WAIT ONSCENE FOR C130?
        TEST L      P15,V23,BBB1       REFUEL BEFORE C130 COMES?
        ASSIGN      15-,C1             COMPUTE WAIT FOR C130
        MSAVEVALUE  7,P16,4,C1,H       LOG TIME HELO TOOK MSG
        MSAVEVALUE  7,P16,5,P12,H      LOG # OF HELO
        ADVANCE     P15                HELO WAIT FOR C130
        TRANSFER    ,AAA1              TEST HELO ON SCENE
AAA3    TEST GE     P16,30,AAA4        AT MATRIX CAPACITY?
        ASSIGN      16,0               ZERO MATRIX ROW COUNTER
```

```
AAA4  ASSIGN      16+,1                  INCREMENT TO NEXT MSG
      TRANSFER    ,AAA2
BBB1  TEST NE     P16,1,HLSC1            DON'T RESET IF = 1
      TEST L      P16,1,BBB2
      ASSIGN      16,30                  RESET COUNTER
BBB2  ASSIGN      16-,1                  REJECT MSG
HLSC1 TABULATE    OSTMH                  TABULATE ON SCENE TIME FOR HELO
      MSAVEVALUE  8,P1,4,M1,H            LOG ON SCENE TIME
      PREEMPT     P12,PR,RES2,7,RE       ALLOW NO ONE TO USE HELO
      ADVANCE     P6                     RETURN TO HP1
      MSAVEVALUE  8,P1,5,C1,H            LOG RETURN TIME
      ADVANCE     P10                    REFUEL
      GATE LS     36,HHT01               * HAS AN E PKG BEEN DELIVERED?
HHT11 TEST G      XH2,0,HHG01            * TEST IF MORE SAL. TEAMS TO DL
      TRANSFER    ,WAIT                  PICK UP SALVAGE TEAM
GOERL LOGIC S     12                     TELL HELO3 TO WAIT FOR SAL. TEA
HHT01 TEST G      XH16,0,HHT11     * THIS HELO HAVE PP E PKG TO DELIVER
HHG01 TEST LE     XH26,0,HHG41           IS E PKG WATING DLVR FM HP1?
HHG21 TEST NE     BV4,0,HHG30            IF WAIT FOR HELO, GO TO SCENE
HHG11 TEST G      P8,11,BOV26            IF V26<11, BOMBOUT
      ASSIGN      11,0                   NOTE HELO EMPTY THIS TRIP
      ASSIGN      13,V17     LOG TIME C130 MUST ARRIVE FOR HELO TO WOR
      TRANSFER    ,HGSC1                 GO TO SCENE
HHT21 RELEASE     LOADH                  THRU LOADING E PKG'S AT HP1
      TRANSFER    ,HHG21                 RESUME
HHG31 TEST G      MH7(P16,3),0,HHT71     HAS NEXT MSG BEEN SENT?
      TEST E      MH7(P16,5),0,HHT81     DID ANY HELO RECEIVE MSG?
HHT41 TEST GE     MH7(P16,3),C1,HHT61    WAS MSG SENT LONG BEFORE HELO A
      ASSIGN      4,C1                   LOG PRESENT TIME
      ASSIGN      4+,P5                  LOG TIME ARRIVE SCENE IF LEAVE
      ASSIGN      3,0
      TEST G      MH7(P16,3),P4,HHT51    CAN HELO DELAY BEFORE TAKING OF
      ASSIGN      3,MH7(P16,3)           COMPUTE WAITING TIME BEFORE
      ASSIGN      3-,P4                     TAKING OFF
HHT51 MSAVEVALUE  7,P16,5,P12,H          LOG THIS HELO TOOK MSG
      MSAVEVALUE  7,P16,4,C1,H              AT THIS TIME
      ASSIGN      15,MH7(P16,3)          TAKE MESSAGE
      ADVANCE     P3                     WAIT BEFORE TAKING OFF
      TRANSFER    ,HHG11                 PREPARE TO GO TO SCENE
HHT61 MSAVEVALUE  P16,5,10,H             LOG MSG RECEIVED TOO LATE
HHT81 TEST NE     P12,MH7(P16,5),HHT41    WAS MSG RECEIVED BY THIS HELO
HHG30 TEST GE     XH19,K30,HHT31         HAS ROW 30 BEEN REACHED?
      SAVEVALUE   19,0,H                 RESET TO ZERO
HHT31 SAVEVALUE   19+,1,H                INCREMENT MSG COUNTER
```

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        ASSIGN      16,XH19                  TELL HELO WHICH MSG TO TEST
        TRANSFER    ,HHG31
HHT71   ADVANCE     10                       WAIT 10 MINUTES AND RETEST
        TRANSFER    ,HHG21
HHG41   SEIZE       LOADH
        TEST G      XH26,0,HHT21             IF HERE BY MISTAKE, GO TO HHT21
        TEST E      BV*12,0,HHG61            WHICH HELO,WHAT TYPE?
        SAVEVALUE   26-,1,H                  * LOAD 1/3 E PKG INTO HH52
        TRANSFER    ,HHG71
HHG61   SAVEVALUE   26-,3,H                  * LOAD E PKG INTO HH3
HHG71   RELEASE     LOADH
        ADVANCE     30                       LOADING TIME
        SPLIT       1,HHG81                  * START E PKG COUNTER
        TEST G      P9,11,BOV27              IF V27<11, BOMBOUT
        ASSIGN      11,2                     LOG HELO CARRIED E PKG
        ASSIGN      13,V18                   LOG TIME C130 MUST ARRIVE SO
        TRANSFER    ,HGSC1
HHG81   TEST E      BV*12,0,GTS1
        TEST E      XH28,3,HHG91
        SAVEVALUE   28,1,H                   * RESET XH28 FOR NEXT 3 PARTS
GTS1    ADVANCE     P5
        ADVANCE     5
        ASSIGN      2,0
        SPLIT       1,REPKG                  * E PKG DELIVERED
        ADVANCE     15                       * SET UP HLD
        LOGIC S     34                       * AN HLD SET UP
        TERMINATE   0                        * E PKG DELIVERED
HHG91   SAVEVALUE   28+,1,H                  * INCREASE COUNT
        TERMINATE   0
HELO2   PREEMPT     2,PR                     ALLOW NO ONE TO USE HELO2
        TEST G      XH17,0,CPTR2             HELO2 HAS PREPOSITIONED E PKG?
ASSGN   ADVANCE     5                        CALL UP HELO2
        ASSIGN      5,V11
        ASSIGN      6,V12
        ASSIGN      7,V34
        ASSIGN      8,V35
        ASSIGN      9,V36
        ASSIGN      10,V32                   REFUELING TIME
        ASSIGN      12,2                     HELO # 2
        TEST G      K10,P9,HHG42
        TEST G      XH42,4,BOV36             IS HELO2 AN HH3?
        SAVEVALUE   42,3,H
        PRINT       42,42,XH    OUTPUT THAT HELO2 MUST BE AN HH3
        TRANSFER    ,ASSGN                   REASSIGN VALUES
HHG42   TEST NE     XH17,0,HHG32  IS HELO2 IN THIS PROBLEM SOLELY FOR H
HHT42   ADVANCE     30                       LOAD HELO2 WITH E PKG
```

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      TEST E      BV*12,0,HHG62
      SAVEVALUE   27-,1,H                  LOAD 1/3RD E PKG INTO HH52
      TRANSFER    ,HHG72
HHG62 SAVEVALUE   27-,3,H                  LOAD E PKG INTO HH3
HHG72 ASSIGN      11,2                     LOG CARRIED AN E PKG
      SAVEVALUE   31+,1,H
      ASSIGN      1,XH31
      MSAVEVALUE  8,P1,1,P12,H
      MSAVEVALUE  8,P1,2,C1,H
      MSAVEVALUE  8,P1,6,P11,H
      ADVANCE     P5                       GO TO SCENE
      MSAVEVALUE  8,P1,3,C1,H              LOG TIME ARRIVE AT SCENE
      MARK                                 RESET MARK TIME, HELO AT SCENE
      ADVANCE     10
      SPLIT       1,HHG82                  UNLOAD HELO2
      SAVEVALUE   33,P9,H
      SAVEVALUE   33-,K10,H  LOG HOW LONG HELO2 CAN STAY ON SCENE
      TEST E      BV4,1,HLSC2              IS ANYTHING WAITING FOR A HELO?
      TEST GE     XH33,30,HLSC2            CAN HELO2 STAY ON SCENE 30 MIN?
      SAVEVALUE   33-,K30,H
      RETURN      2                        HELO2 AVALIABLE FOR OTHER WORK
      ADVANCE     30                       HELO2 AVAILABLE FOR OTHER WORK
      PREEMPT     2,PR,RES2,7,RE              FOR 30 MINUTES ONLY
HLSC2 TABULATE    OSTMH                    LOG HELO2 LEAVE SCENE &
      MSAVEVALUE  8,P1,4,M1,H                 TABULATE ON SCENE TIME
      TEST G      XH27,0,HHT02             ARE THERE ANY MORE E PKGS AT HP
      ADVANCE     P6                       RETURN TO HP2
      MSAVEVALUE  8,P1,5,C1,H              LOG TIME OF RETURN
      ADVANCE     P10                      REFUEL HELO2
      TRANSFER    ,HHT42                   NEXT TRIP
HHT02 GATE LS     2,FINIS                  ARE WE THRU WITH HELO2?
      SAVEVALUE   33+,P6,H   LOG REMAINING ENDURANCE OF HELO2 TO HP1,2
      TEST GE     XH33,V20,HHG02           CAN HELO2 GO TO HP1 DIRECTLY?
      ASSIGN      5,V19
      ASSIGN      6,V20      TIMES TO & FM SCENE -HP1
      ASSIGN      9,V37
      ADVANCE     P6                       GO TO HP1
      MSAVEVALUE  8,P1,5,39,H              LOG ARRIVAL IS IN XH39
      SAVEVALUE   39,C1,H                  LOG TIME OF ARRIVAL AT HP1
      ADVANCE     P10                      REFUEL
      TRANSFER    ,HHG01                   USE HELO2 AT HP1
CPTR2 GATE LS     2,FINIS    FINISH DETERMINING IF HELO2 IS IN THIS
      TRANSFER    ,ASSGN            PROBLEM
HHG02 ADVANCE     P6                       RETURN TO HP2
      MSAVEVALUE  8,P1,5,C1,H              LOG TIME OF RETURN
```

```
         ADVANCE     P10                     REFUEL
GOHP1    ASSIGN      5,V19
         ASSIGN      6,V20                   TIMES TO & FM SCENE - HP1
         ASSIGN      9,V37                             .
         TEST GE     V38,V21,HHG52           CAN HELO2 REACH HP1 W/O FUELING:
         ADVANCE     V21                     GO TO HP1
         SAVEVALUE   39,C1,H                 LOG TIME ARRIVE AT HP1
         MSAVEVALUE  8,P1,5,K39,H
         ADVANCE     P10                     REFUEL
         TRANSFER    ,HHG01                  USE HELO2 AT HP1
HHG52    SAVEVALUE   33,V21,H
HHT52    ADVANCE     V38                     GO TO HP1, REFUELING ON WAY
         ADVANCE     P10
         SAVEVALUE   33-,V38,H
         TEST LE     XH33,0,HHT52
         SAVEVALUE   39,C1,H
         MSAVEVALUE  8,P1,5,K39,H
         TRANSFER    ,HHG01
HHG82    TEST E      BV*12,0,GTS1
         TEST E      XH29,3,HHG92
         SAVEVALUE   29,1,H                  * RESET XH29 FOR NEXT 3 PARTS
         TRANSFER    ,GTS1
HHG92    SAVEVALUE   29+,1,H                 INCREASE COUNT PARTS E PKG DLVD
         TERMINATE   0
HELO3    PREEMPT     3,PR                    ALLOW NO ONE TO USE HELO
         GATE LS     3,FINIS
         ADVANCE     XH50                    CALL UP HELO3 AND CREW
         ASSIGN      5,V13                   HELO3 TIME TO SCENE
         ASSIGN      6,V14                   HELO3 TIME TO HP1 FM SCENE
         ASSIGN      7,V28                   HELO3 ON SCENE ENDURANCE, S T
         ASSIGN      8,V29                   HELO3 ON SCENE ENDURANCE, EMPTY
         ASSIGN      9,V30                   HELO3 ON SCENE ENDURANCE, EPKG
         ASSIGN      10,V33                  HELO3 REFUEL TIME
         ASSIGN      12,3                    THIS IS HELO3
         GATE LR     12,WAIT                 WAIT FOR S T IF HELO1 DIDN'T
         TRANSFER    ,HHG01                  HELO3 READY TO WORK
**********                                   DELIVERY SUBROUTINE
*
ONEP     SAVEVALUE   10+,K1,H                * ADD 1 TO XH10
         ASSIGN      1,XH10                  * ASSIGN TO P1 THE # IN XH10
         ASSIGN      3+,K1                   LABEL TRIP
         QUEUE       WLDR                    * QUEUE C130 FOR LDR
         ENTER       LDR00                   * LOADER NOW BUSY
         DEPART      WLDR
         MSAVEVALUE  5,P3,P2,C1,H            LOG TIME START LOADING
```

```
        SPLIT       1,SMSG                  TELL HELO WHEN C130 WILL ARRIVE
        ADVANCE     XH15                    LOAD 2 PKG'S ON C130
        LEAVE       LDR00                   * LDR READY FOR NEXT C130
        ASSIGN      8,C1                    * LOG TIME C130 TAKES OFF
        GATE LR     52,GTSC
        GATE LR     10,GTSC
        GATE LR     8,GTSC                  IF TEAM ALREADY DLVD, GTSC
        LOGIC S     8                       TEAM DLVD
        ADVANCE     V4
        LOGIC S     52                      * TRNF PERS. TO WAITING HELO
        SAVEVALUE   18,C1,H                 LOG TIME SALVAGE TEAM ARRIVE HP
        ADVANCE     V5                      * GO TO SCENE FM HELOPORT
        TRANSFER    ,ATSC
GTSC    ADVANCE     V6                      * GO TO SCENE
ATSC    QUEUE       WDZ                     * WAIT FOR DROP ZONE
        ENTER       DZONE                   * C130 RDY DROP, ZONE CLEAR
        DEPART      WDZ
        SAVEVALUE   21,C1,H     TEMPORARILY LOG TIME C130 ARRIVES AT
        TEST NE     P3,MH1(XH*10,P2),EPKG1            IS EPKG ON C130?
        ADVANCE     10                      * DROP BAG PKG
        SPLIT       1,BFILL                 1ST BAG PKG NOW IN WATER
        ADVANCE     10                      * DROP BAG PKG
        LEAVE       DZONE                   * C130 LEAVE DROP ZONE
        SPLIT       1,BFILL                 * 2ND BAG PKG NOW IN WATER
ACFTR   ADVANCE     V7                      C130 RETURN TO ECAS
        MSAVEVALUE  2,P3,P2,C1,H            LOG TIME OF RETURN
        TEST GE     V2,0,CCREW   CAN THIS CREW MAKE ANOTHER TRIP?
        TRANSFER    ,ONEP                   C130 NOW READY FOR RELOADING
CCREW   TEST G      XH22,0,NCREW            ANY SPARE CREWS?
        SAVEVALUE   22-,1,H                 TAKE NEW CREW
        ASSIGN      16,C1                   LOG TIME NEW CREW ASSIGNED
        TRANSFER    ,ONEP
NCREW   SAVEVALUE   24-,1,H                 ONE LESS C130
        TEST G      XH24,0,BOUT             END RUN IF NO C130'S LEFT
        TRACE
        PRINT       22,24,XH
        TERMINATE   0                       REMOVE C130
EPKG1   SAVEVALUE   P10+,1,H                * RESET TEST FOR NEXT E PKG
RES7    QUEUE       WHELO
FSTH1   GATE LR     6                       IS ANY HELO AVAILABLE?
        GATE NU     1,SECH1                 IS HELO1 AVAILABLE?
        PREEMPT     1,PR,RES4,7,RE          * HELO1 IN USE
        ASSIGN      9,1                     * LOG HELO1 USED
        TRANSFER    ,RES1
SECH1   GATE NU     2,TRDH1                 IS HELO2 AVAILABLE?
```

```
         PREEMPT     2,PR,RES4,7,RE           * HELO2 IN USE
         ASSIGN      9,2                      * LOG HELO2 USED
         TRANSFER    ,RES1
TRDH1    GATE NU     3,NOHH1                  IS HELO3 AVAILABLE?
         PREEMPT     3,PR,RES4,7,RE           HELO3 IN USE
         ASSIGN      9,3                      * LOG HELO3 USED
         TRANSFER    ,RES1
NOHH1    LOGIC S     6
         TRANSFER    ,FSTH1
RES1     DEPART      WHELO
         MARK                       TEMPORARILY LOG TIME HELO SEIZED
         ADVANCE     10                       * DROP E PKG
         SPLIT       1,EPKG                   * E PKG NOW IN WATER
         ADVANCE     10                       * DROP BAG PKG
         LEAVE       DZONE                    * C130 LEAVE DROP ZONE
         SPLIT       1,ACFTR                  * RETURN C130
         SPLIT       1,BFILL                  * B PKG NOW IN WATER
         GATE LS     9                        * THRU WITH HELO?
         RETURN      P9                       * RELEASE HELO
RES6     LOGIC R     9                        *
         TERMINATE   0
*********
*                                             E PACKAGE SET UP ROUTINE
EPKG     ASSIGN      4,C1
         ADVANCE     10                       * DELIVER HLD
         ADVANCE     10                       * DELIVER MSGR OR TOW
         LOGIC S     9                        * RELEASE HELO
         LOGIC R     6
         LOGIC R     7
         SPLIT       1,UHLD        SPLIT E PKG F HLD AND SET UP BOTH
         ADVANCE     5                        * FINISH SETTING UP HLD
         LOGIC S     34                       * HLD READY
         TERMINATE   0
UHLD     LOGIC S     11                       GIVE EPKG PRIORITY OVER BAGS
         ENTER       HAUL                     * DECREASE # AV. HLD BY 1
         LOGIC R     11
         GATE LR     2,TEPKG                  * CAN HELO'S TOW?
         ADVANCE     35                       * HLD HAUL IN E PKG
HLDF     LEAVE       HAUL                     * HLD FREE
REPKG    LOGIC S     36                       * S = 1ST E PKG DELIVERED
         ADVANCE     20                       * SET UP & TEST E PKG
         LOGIC S     35                       * E PKG READY
         SAVEVALUE   1+,K1,H
         MSAVEVALUE  3,XH1,1,C1,H             * LOG TIME E PKG READY
         MSAVEVALUE  3,XH1,2,P12,H            LOG HELO NUMBER
         MSAVEVALUE  3,XH1,3,P2,H             LOG C130 NUMBER
```

```
        TERMINATE   0
 TEPKG  ADVANCE     17                       * HLD FINISH HAULING,LIFTING
        TRANSFER    ,HLDF
**********                                   BAG FILLING ROUTINE
*
 BFILL  ASSIGN      4,C1                     * LOG TIME BAG DROPPED
        PRIORITY    1
 RES3   QUEUE       WCPTR                    * IS HELO AVAILABLE?
 FSTH9  GATE LR     7
        GATE NU     1,SECH9
        SEIZE       1                        * HELO1 IN USE
        ASSIGN      9,1                      * LOG HELO1 USED
        TRANSFER    ,RES9
 SECH9  GATE NU     2,TRDH9
        SEIZE       2                        * HELO2 IN USE
        ASSIGN      9,2                      * LOG HELO2 USED
        TRANSFER    ,RES9
 TRDH9  GATE NU     3,NOHH9
        SEIZE       3                        * HELO3 IN USE
        ASSIGN      9,3                      * LOG HELO3 USED
        TRANSFER    ,RES9
 NOHH9  LOGIC S     7
        TRANSFER    ,FSTH9
 RES9   DEPART      WCPTR
        ADVANCE     10                       * DELIVER MSGR(OR TOW)
        RELEASE     P9                       * THRU WITH HELO
 RES5   LOGIC R     7
        LOGIC R     6
        QUEUE       WHLD                     * IS HLD AVAILABLE?
        GATE SNF    HAUL
        GATE LR     11                       WAIT IF EPKG NEEDS HLD
        ENTER       HAUL                     * DECREASE # OF AVAIL. HLD'S BY 1
        DEPART      WHLD
        GATE LR     5,TOW                    * CAN HELO'S TOW?
        ADVANCE     30                       * HAUL BAG IN
 LHAUL  LEAVE       HAUL                     * THRU W/HLD, AVAIL. HLD +1
        QUEUE       WEPKG                    * IS E PKG AVAIL.?
        GATE LR     4,MFD                    * ARE THERE MANIFOLD?
        ENTER       EPG                      DECREASE # OF AVAILABLE
        DEPART      WEPKG                    *    E PKG'S BY 1
        ADVANCE     12                       * HOOK UP BAG
        ASSIGN      5,C1                     * LOG TIME START FILLING BAG
        ADVANCE     120                      * FILL BAG
        ASSIGN      6,C1                     * LOG TIME FINISHED FILLING BAG
        ADVANCE     12                       * DISCONN BAG, MOVE OUT OF WAY
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      LEAVE       EPG                          * INCREASE # AVAIL. E PKG'S +1
BFULL SAVEVALUE   4+,K1,H                      * STORE INFO ON BAGS
      ASSIGN      7,XH4                        * (P7 IS ROW)
      MSAVEVALUE  4,P7,1,P1,H
      MSAVEVALUE  4,P7,2,P2,H                          .
      MSAVEVALUE  4,P7,3,P3,H
      MSAVEVALUE  4,P7,5,P4,H                  * LOG BAG DATA
      MSAVEVALUE  4,P7,6,P5,H
      MSAVEVALUE  4,P7,7,P6,H
      MSAVEVALUE  4,P7,8,P7,H
      MSAVEVALUE  4,P7,4,P8,H
      MSAVEVALUE  4,P7,9,P9,H
      TERMINATE   1                            * REDUCE START COUNT BY 1
TOW   ADVANCE     2                            * FINISH POSITIONING BAG
      TRANSFER    ,LHAUL                       * GO TO LHAUL
MFD   ADVANCE     12                           * HOOK UP BAG TO MFD
      ENTER       EPG                          * DECREASE # AVA. E PKG -1
      ADVANCE     1                            * SWITCH BAGS
      DEPART      WEPKG
      ASSIGN      5,C1                         * LOG TIME START FILLING BAG
      ADVANCE     120                          * FILL BAG
      ASSIGN      6,C1                         * LOG TIME BAG FULL
      LEAVE       EPG
      ADVANCE     12                           * DISCONN BAG
      TRANSFER    ,BFULL
SMSG  ASSIGN      16,V8          LOG ONLY THOSE MSGS WITH
      ASSIGN      16-,15           INTERARRIVALS GREATER THAN
      ASSIGN      4,XH9                        ASSIGN ROW # TO MESSAGE
      TEST G      P16,MH7(P4,3),FINIS          FIFTEEN MINUTES.
      SAVEVALUE   9+,1,H                       SET ROW COUNTER FOR MH7
      TEST E      P4,8,SMSG3
      SPLIT       1,SMSG3
      SAVEVALUE   12,P4,H
      TRANSFER    ,SMSG1
SMSG3 MSAVEVALUE  7,P4,6,P1,H                  LOG MSG NUMBER
      MSAVEVALUE  7,P4,3,V8,H                  LOG TIME C130 EXPECTS TO ARRIVE
      MSAVEVALUE  7,P4,1,P2,H                  LOG WHICH C130
      MSAVEVALUE  7,P4,2,P3,H                  LOG WHICH C130 TRIP
      TEST E      XH9,31,FINIS                 MATRIX CAPACITY = 30 ROWS
      SAVEVALUE   9,1,H                        RESET ROW COUNTER
      PRINT       7,7,MH                       PRINT PRESENT MH7
      SAVEVALUE   12,1,H                       RESET
SMSG1 TEST LE     XH12,30,FINIS                HAVE WE FINISHED RESETTING?
      TEST L      MH7(XH12,3),C1,SMSG2         IS MSG STILL VALID?
      MSAVEVALUE  7,XH12,3,0,H
      MSAVEVALUE  7,XH12,4,0,H
      MSAVEVALUE  7,XH12,5,0,H                 CLEAR COLUMNS 3 THRU 5
```

```
 SMSG2 SAVEVALUE    12+,1,H              INCREMENT
       TRANSFER     ,SMSG1
 RES4  ADVANCE      P7                   ADVANCE REMAINING TIME, HELO
       TRANSFER     ,RES5                   CONTINUES WORK & STDBY FOR AC
 RES2  TEST E       PR,3,RES3            SEND BAGS BACK TO THEIR ROUTINE
       TEST GE      M1,10,RES7           DID C130 DROP E PKG?
       TEST L       M1,20,RES6           DID C130 DROP BAG PKG?
       ADVANCE      10                   C130 NO LONGER NEEDS HELO, DROP
       LEAVE        DZONE                   BAG PKG & LEAVE DROP ZONE
       SPLIT        1,ACFTR              RETURN C130
       TRANSFER     ,BFILL               BAG PKG NOW IN WATER
**********                               BOMB-OUT SUBROUTINES
*
 BOV22 LOGIC S      222                  BOMBOUT V22<10
 BOUT  TRACE
       TERMINATE    48             * SHUT DOWN BAGSIM DUE TO BOMBOUT
 BOV26 LOGIC S      226                  BOMBOUT V26<10
       TRANSFER     ,BOUT
 BOV27 LOGIC S      227                  BOMBOUT V27<10
       TRANSFER     ,BOUT
 BOV36 LOGIC S      236                  BOMBOUT V36<10
       PRINT        1,236,LG
       GATE LS      2,FINIS              IS HELO2 WANTED AT HP1?
 HHG32 SAVEVALUE    31+,1,H
       ASSIGN       1,XH31
       TRANSFER     ,GOHP1
       START        10,,,1
       START        30
       END
```

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APPENDIX B

DEFINITIONS OF ACRONYMS AND ABBREVIATIONS

ADAPTS	The acronym for the Air Deliverable Anti-Pollution Transfer System. It is described in Chapter 1.
BAGSIM	The acronym for the ADAPTS simulation model; it comes from Bag and Simulation.
BVn	Boolean Variable n (n is the serial number of the boolean variable). These variables can have a value of one or zero only.
ECAS	U. S. Coast Guard Air Station, Elizabeth City, North Carolina.
E pkg	Equipment package; it consists of a Diesel - hydraulic power supply fuel, a submersible pump, connecting hoses, and HLD.
GPSS	General Purpose Simulation System. A block oriented computer language for simulation models.
HLD	Hauling and Lifting Device. An aircraft deliver A-frame complete with rigging tackle and manual winch. It is a component of an E pkg.
HP1	Helo Port 1. The helicopter equipped CG Air Station nearest to the scene.
HP2	Helo Port 2. The backup helicopter equipped CG Air Station. It is the next nearest to the scene.
MHn	Halfword Matrix n (n is the serial number of the matrix).
NYC	New York City.
PERT/CPM	Program Evaluation and Review Technique/Critical Path Method which as used for network analysis. The specific method use in this report was the Integrated Civil Engineering System program called PROJECT 1 released by the Massachusetts Institute of Technology.
Vn	Variable n (n is the serial number of the variable). It is a defined formula used for computation during a computer run of BAGSIM.
XHn	Halfword Savevalue n (n is the serial number of the halfword savevalue). A save number, either initially set into the computer run or computed during the run.

APPENDIX C

BOOLEAN VARIABLES, BVn

Number	Equation	Meaning
BV1	XH41'L'4	Helo 1 is 1 = HH3F 0 = HH52A
BV2	XH42'L'4	Helo 2 is 1 = HH3F 0 = HH52A
BV3	XH43'L'4	Helo 3 is 1 = HH3F 0 = HH52A
BV4	Q$WCPTR+Q$WHELO	0 = no waits for helo 1 = a helo queue is formed
BV5	FU*12+BV4	0 = helo not in use 1 = helo being used
BV6	P2'G'O*P2'L'4*P2'NE'P12	1 = a message has been taken and message was not late and the asking helo did not take the message. 0 = at least one of the conditions was not met.

FLOATING POINT VARIABLES, FVn

Floating point variables are not used by BAGSIM although they are available in GPSS/360.

ARITHMETIC VARIABLES, Vn

Number	Equation	Meaning
V1	C1-XH21	Lapsed time since last C-130 arrive scene.
V2	XH23+P16-C1-V6-V7-20	Crew time available after next trip
V3	60*XH40/270	C-130 time to HP1 fm BAS
V4	60*XH6/270	C-130 time to HP1 fm ECAS
V5	10+60*XH7/270	C-130 time to scene fm HP1
V6	60*XH5/270	C-130 time to scene fm ECAS
V7	60*XH5/290	C-130 time to return to ECAS

Number	Equation	Meaning
V8	XH15+V6+C1	Time C-130 arrives at scene
V9	60*(1-BV1) *XH7/85+60*BV1*XH7/115	1st Helo time to scene fm HP1
V10	60*(1-BV1)*XH7/95+60*BV1*XH7/125	1st Helo time to HP1 fm scene
V11	60*(1-BV2)*XH8/85+60*BV2*XH8/115	2nd Helo time to scene fm HP2
V12	60*(1-BV2)*XH8/95+60*BV2*XH8/125	2nd Helo time to HP2 fm scene
V13	60*(1-BV3)*XH7/85+60*BV3*XH7/115	3rd Helo time to scene fm HP1
V14	60*(1-BV3)*XH7/95+60*BV3*XH7/125	3rd Helo time to HP1 fm scene
V15	50+P2	for addressing HXj where j equals the C-130 number plus 50.
V16	C1+P7-11	time by which C-130 must reach scene if Helo1 is to serve it.
V17	C1+P8-11	
V18	C1+P9-11	
V19	60*(1-BV2)*XH7/85+60*BV2*XH7/115	Helo2 time to scene fm HP1
V20	60*(1-BV2)*XH7/95+60*BV2*XH7/125	Helo2 time to HP1 fm scene
V21	60*(1-BV2)*XH20/85+60*BV2*XH20/115	Helo2 time from HP2 to HP1
V22	150+158*BV1-V9-V10	On scene endurance with transit time accounted.
V23	P5+56+P10	time for helo to return, refuel & go back out
V24	3*XH16	0 if no E pkgs to be carried fm HP1
V25	3*XH17	0 if no E pkgs to be carried fm HP2
V26	270+82*BV1-V9-V10	time that Helo1 stays on scene if unloaded

Number	Equation	Meaning
V27	120+62*BV1-V9-V10	time Helo1 stays on scene if carrying E pkg
V28	150+158*BV3-V13-V14	Helo3 on scene endurance if a salvage team is carried
V29	270+82*BV3-V13-V14	Helo3 on scene endurance if no load is carried
V30	120+62*BV3-V13-V14	Helo2 on scene endurance if an E pkg is carried
V31	20+10*BV1	Average time to refuel 1st helo
V32	20+10*BV2	Average time to refuel 2nd helo
V33	20+10*BV3	Average time to refuel 3rd helo
V34	150+158*BV2-V19-V20	Helo2 on scene endurance S.T. carried from HP1
V35	270+82*BV2-V19-V20	Helo2 on scene endurance empty from HP1
V36	120+62*BV2-V11-V12	Helo2 on scene endurance pkg carried from HP2
V37	120+62*BV2-V19-V20	Helo2 on scene endurance E pkg carried from HP1
V38	270+82*BV2	total endurance HP1 Helo2

APPENDIX D

FULLWORD SAVEVALUES, Xn

Fullword savevalues are not used by BAGSIM although they are available in GPSS/360.

HALFWORD SAVEVALUES, XHn

Number	Allowable Range	Meaning
1	1 - 20	number of E pkg's set up (used as row for MH3)
2	1 up	# of 4 man salvage teams
3	1 - 15	# of C-130's
4	1 up	Bag # assigned after bag is filled (used as row for MH4)
5	0 up	Distance in nautical miles from ECAS to scene
6	0 up	Distance in nautical miles from ECAS TO HP1
7	0 up	Distance in nautical miles from HP1 to scene
8	0 up	Distance in nautical miles from HP2 to scene
9	1 up	Message #
10	1 up	Counter to serially number the plane loads
11	1 - 15	Serial number of C-130
12	1 - 30	Row counter for resetting MH7 contents to zero
13	Not Used	
14	0 up	Average time needed to install rails in C-130
15	0 up	Average time needed to load a C-130 with two packages

Number	Allowable Range	Meaning
16	0 - 20	# of E pkgs at HP2
17	logged time	time C-130 leaves salvage teams at HP1
19	1 - 30	Counter used by helos to select message
20	0 up	Distance in nautical miles from HP1 to HP2
21	logged time	The most recent time any C-130 arrived at scene, used by helos when deciding to leave scene
22	0 up	number of extra (spare) air crews for C-130's
23	0 - 15	number of C-130's left
24	0 up	C-130 crew endurance in minutes, see CG-333 for the standards
25	Not Used	
26	0 - V24	Counter for # of 1/3 E pkgs left to be delivered from HP1
27	0 - V25	Counter for # of 1/3 E pkgs left to be delivered from HP2
28	1 - 60	Initially = 1, Counter for Helo deliver of 1/3 E pkgs
29	1 - 60	Initially = 1, Counter Helo2 delivery of 1/3 E pkgs
30	Not Used	

Number	Allowable Range	Meaning
31	1 up	Helo trip number
32	Not Used	
33	Initially time Helo2 stays on scene when carrying E pkgs from HP2 and then used in refueling Helo2 when enroute HP1 from HP2	
34 - 38	Not Used	
39	Logged time	Time Helo2 arrives at HP1 for work
40	0 up	Distance in nautical miles from BAS to HP1
41	3, 52	Type of helicopter, Helo1
42	3, 52	Type of helicopter, Helo2
43	3,52	Type of helicopter, Helo3
50	0 up	Standby time for Helo3
51 - 65	0 up	First used for standby of jth C-130 (50+j=XHn) then used for E pkg subroutine

APPENDIX E

FULLWORD MATRICES, MXn

Fullword matrices are not used by BAGSIM although they are available in GPSS/360.

HALFWORD MATRICES, MHn

I. MH1 is the only input matrix; it is for the E pkgs to be delivered by the C-130's. The i-th row represents the i-th E pkg delivered by a given C-130. The j-th column represents the j-th C-130. Hence MH(1,3),4 (the number 4 is in position row 1, column 3 of MH1) means that the 3rd C-130 makes its 1st E pkg delivery on its 4th trip. MH1 is limited to 3 rows and 15 columns. The numbers in a column must be zero or positive integers with increasing value going down a column except that zero may be after the last positive number.

Sample of MH1:

MATRIX HALFWORD SAVEVALUE 1
(C-130 Numbers)

	Col. 1	2	3	4	5
Row 1	1	1	0	2	0
(E PKG) 2	2	3	0	0	0
3	3	0	0	0	0

II. In MH2 the times that C-130's return to ECAS are logged in the column with the same number as the C-130. There can be up to 30 returns (rows) by each of the 15 C-130's (columns).

(C-130 Number)

	Col. 1	2	3	15
Row 1	186	251	253	0
(Trip 2	331	time of return		
No.) :				
30	0	0		0

III. In MH3 the time when each E pkg is set up is logged in column 1. The helo that delivered it is numbered in column 2 with zero meaning no helo. The C-130 that delivered it is numbered in column 3 with zero meaning no C-130. If column 2 has a zero in it, column 3 must have a positive number in it for each row that has a set up time in column 1. There can be up to 20 E pkgs (rows) for this three column matrix.

	(Time set up)	(Delivered by helo)	(Delivered by C-130)
Col.	1	2	3
Row 1	113	1	0
(E pkg) 2	216	0	1
3	239	2	0
20	0	0	0

IV. In MH4 the information on the filled bags is logged. It is defined for 40 bags (rows) with 9 columns of information. The bags are logged in the same order they are filled with the columns containing:

COLUMN	ALLOWABLE RANGE OF CONTENTS	MEANING
1	1 - 40	order in which left storage at ECAS
2	1 - 15	which C-130 carried bag
3	1 - 20	C-130 trip number
4	logged time	time left ECAS
5	logged time	time bag dropped by C-130
6	logged time	time bag is ready for filling
7	logged time	time bag is full
8	1 - 40	order in which filled (repeats row number)
9	1 - 3	Helo used to deliver bag pkg messenger.

If a bag was filled, all spaces in its row must have numbers greater than zero.

Sample of MH4 in which 10 bags have been filled:

MATRIX HALFWORD SAVEVALUE 4

	COL.	1	2	3	4	5	6	7	8	9
Row	1	1	1	1	103	169	232	352	1	3
	2	3	3	1	178	206	288	408	2	1
	3	5	5	1	178	244	297	417	3	2
	4	3	3	1	178	216	298	418	4	1
	5	4	4	1	178	226	353	473	5	2
	6	2	2	1	178	234	409	529	6	1
	7	5	5	1	178	254	418	538	7	1
	8	4	4	1	178	236	419	539	8	1
	9	6	1	2	276	304	453	573	9	3
	10	6	1	2	276	314	474	594	10	3
	11	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	0

V. In MH5 the time that C-130's begin loading for each trip is logged; these can be up to 30 loadings (rows) for each C-130 (column). This matrix resembles MH2.

VI. MH6 is not used.

VII. In MH7 the C-130 messages and their status is logged. Since each C-130 can make up to 30 trips, there are 30 x 15 = 450 possible messages, but to save room, this matrix is defined for 30 rows only. This means it can hold 30 messages so when 30 messages are placed into it, it is printed and partially zeroed to allowed room for the next 30 messages. The columns represent:

Column	Allowable Range Of Contents	Meaning
1	1 - 15	Identifies which C-130 sent message
2	1 - 30	C-130 trip number
3	time	expected time for C-130 to arrive at scene
4	logged time	time message received by helo
5	0 - 3	which helo received this message; 0 = ignored by helo at scene 10 = received too late
6	1 up	message number

A sample of MH7 in which over 30 messages have been logged is:

MATRIX HALFWORD SAVEVALUE 7

	Col.	1	2	3	4	5	6
Row	1	1	7	1025	0	0	31
	2	3	7	1066	0	10	32
	3	2	7	1084	0	10	33
	4	5	7	1104	0	10	34
	5	4	7	1110	0	10	35
	6	1	8	1170	1151	1	36
	7	3	8	1211	0	0	37
	8	2	8	1229	0	0	38

VIII. In MH8 the information on the helicopter trips to the scene is logged. There can be up to 50 trips in total by the helos including the special trip by Helo2 when it shifts from HP2 to HP1 for its base of operations. The special trip is logged with zero in each column except 39 in column 5 The 39 refers to XH39 which then contains the time of HELO2's arrival at HP1. Otherwise each row of MH7 contains the information on a round trip by a helo to the scene. The columns represent:

Column	Allowable Range Of Contents	Meaning
1	1 - 3	Which helo made this trip
2	logged time	Time departed for scene
3	logged time	Time arrived at scene
4	duration	Time stayed on scene
5	logged time	Time arrived back at HP1 or HP2
6	0 = no load 1 = salvage team 2 = E pkg (1/3 pkg if helo is HH-52A)	Type of load carried on this trip

A sample of the beginning of MH8 is:

MATRIX HALFWORD SAVEVALUE 8

	Col.	1	2	3	4	5	6
Row	1	0	0	0	0	39	0
	2	1	44	88	21	149	2
	3	3	105	149	44	233	1
	4	2	170	214	55	309	1

APPENDIX F

LOGIC SWITCHES, LSn or LRn

NUMBER	MEANING
1	R = Helo1 is not used, S = Helo1 available and used
2	R = Helo2 is not used at HP1, S = used at HP2 then HP1
3	R = Helo3 is not used, S = Helo3 available and used
4	R = No manifolds, S = manifolds
5	R = No helo towing, S = Helo tow packages in the water
6	Normally R; S means no helo available for C-130 (at E pkg1 routine)
7	R = Helo available; S = no helo available (after tested for helo)
8	S = 1st C-130 went to HP1
9	Normally R; S releases helo that waited for E pkg drop by C-130
10	S = Salvage teams at New York City and R = Salvage teams at ECAS
11	Normally R; S by E pkg to delay bags when E pkg needs HLD. This helps to establish priority of queue.
12	Normally R; S means Helo1 went to scene early and that Helo3 waited at HP1 for the salvage teams to arrive by C-130
13-33	Not Used
34	R = HLD not set up; S = HLD set up
35	R = E pkg not set up; S = E pkg set up
36	R until at least 1 E pkg has been set up then S
37-50	Not Used

NUMBER	MEANING
51	
52	R until C-130 delivers salvage teams to HP1, then S
53-199	Not Used

The 200 number series is used for logging model failures; that is, conditions which cause this model to be unuseable.

NUMBER	MEANING OF SET
222	S only if Helo1 on scene time, V22, will exceed endurance; causes model to terminate computer run
226	S only if Helo1 on scene time, V26, will exceed endurance; causes model to terminate
227	S only if Helo1 on scene time, V27, will exceed endurance; causes model to terminate
236	S only if HP2 is too far from scene for Helo2 to deliver E pkgs from HP2

APPENDIX G

FACILITIES AND STORAGES

Facilities have a capacity of one user only while the size of storages must be defined. In BAGSIM four facilities and four storages are used as described in Chapter 3. They are:

Name	Size	Meaning
1	1	Helo1
2	1	Helo2
3	1	Helo3
LOADH	1	Only one helo can be loaded at a time
DZONE	2	Only two C-130's can be at the scene at a time
HAUL	2	Can have up to 20 HLD's
EPG	2	Can have up to 20 E pkgs
LDROO	1 or more*	Amount of C-130 loaders, hence, number of C-130's that can be loaded simultaneously

LOADH is now extraneous, it originally was needed to prevent simultaneous loading of the same pump into different helicopters. This can not happen with the present program.

* Defined as an input for each use of BAGSIM.

APPENDIX H

PARAMETER DEFINITIONS FOR TRANSACTIONS

When interpreting the meaning of a number stored in a parameter of a transaction, the position and priority of the transaction in the model are important. They help to define what the transaction represents. Transactions are initially given a priority of 5; they are have 16 parameters. Those transactions that preload storages HAUL and EPG retain a priority of 5 and their 16 parameters each contain zero; any change in these conditions indicates that a bag of E pkg has entered the storage.

1. Helicopters. The helicopters have a priority of 5. The parameter values based upon the helo being at program location HLSC1 are:

PARAMETER	MEANING
1	helo trip number (serially assigned to all helo)
2	status of message
3	waiting time at HP1 before taking this trip
4	projected arrival time at scene before taking this trip
5	HP1 to scene trip time
6	scene to HP1 trip time
7	On scene endurance carrying salvage team
8	On scene endurance carrying nothing
9	On scene endurance carrying E pkg
10	average refueling time
11	load carried this trip
12	Helo number (1, 2, or 3)

PARAMETER	MEANING
13	last time this Helo trip that a C-130 can arrive at scene with enough helo endurance to deliver messenger.
14	time helo must leave scene
15	time a C-130 is expected at scene or time helo must wait for C-130
16	next message to check in MH7

2. C-130 aircraft. The C-130's have a priority of 3. The parameter values are based upon the C-130's being at program location ACFTR are:

PARAMETER	MEANING
1	serial number of bag load
2	C-130#
3	C-130 trip # (serially assigned per C-130)
4 - 7	Not Used
8	time C-130 took off @ ECAS
9	which helo was used last time delivered E pkg
10	XH51 - XH65 C-130 standby address then used for EPKG1 routine
11 - 15	Not Used
16	logged time that C-130 became available for use.

3. Equipment Packages (Epkgs). The helo delivered E pkgs have a priority of 5 while the C-130 delivered E pkgs have a priority of 3. Since these transactions are used only in the delivery of E pkgs, the difference in priority is immaterial except for debugging. The following parameter values are based upon the E pkg being at program location REPKG:

PARAMETER	C-130 DELIVERY MEANING	HELO DELIVERY MEANING
1	order in which left storage at ECAS	Helo trip number (for all helos)

PARAMETER	C-130 DELIVERY MEANING	HELO DELIVERY MEANING
2	which C-130 carried it	zero
3	which C-130 trip	zero
4	time dropped by C-130	zero
5		HP1 to scene trip time
6		Scene to HP1 trip time
7		On scene endurance carrying salvage team
8	time C-130 took off fm ECAS	On scene endurance carrying nothing
9	which helo was used	On scene endurance carrying E pkg
10	which E pkg delivery by this C-130	average refueling time
11		two
12	zero	helo number
13		V16, V17, or V18
14		time when helo must leave scene
15		message time for testing
16	logged time C-130 became available for use	# of message being tested

4. Bags. The bags have a priority of 1. The parameter values are based upon the bag being at program location BFULL:

PARAMETER	MEANING
1	order in which bags leave storage @ ECAS
2	which C-130 carried bag
3	C-130 trip number
4	time bag dropped
5	time bag ready for filling

PARAMETER	MEANING
6	time bag filled
7	order in which bags filled
8	time C-130 took off fm ECAS
9	Helo which towed bag msgr
10	used for E pkg delivery by C-130
11 - 15	Not Used
16	logged time C-130 became available for use

5. Messages. The messages sent by the C-130's to the helo's and HP1 have a priority of 3. The parameter values based upon the messages being at program location SMSG3 are:

PARAMETER	MEANING
1	order in which messages sent
2	which C-130 sent the message
3	C-130 trip number
4	matrix row for message
5 - 15	zero (Not Used)
16	used for interarrival test.

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